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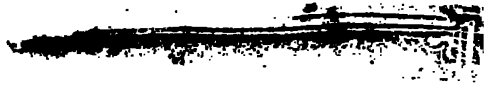




Engraved by J. Horsburgh

BARON F. H. A. HUMBOLDT.





HUMBOLDT'S
Travels and Researches.



THE DRAGON-TREE OF OROTAVA.

One of the most remarkable objects in this place is the Dragon-tree, which our travellers found to be about 80 feet high, with a circumference of 45 feet near the roots.—See Page 45.

T. NELSON AND SONS, LONDON AND EDINBURGH.





Edinburgh Cabinet Library—New Edition.

THE
TRAVELS AND RESEARCHES
OF
ALEXANDER VON HUMBOLDT.

BY
W. MACGILLIVRAY, LL.D. F.R.S.E.
Professor of Natural History in Marischal College and University of Aberdeen.

Enlarged Edition.

WITH A NARRATIVE
OF
HUMBOLDT'S MOST RECENT RESEARCHES

INCLUDING
HIS CELEBRATED JOURNEY TO THE URAL MOUNTAINS,
EXPLORATION OF THE ALTAIAN RANGE,
AND THE CASPIAN SEA, &c. &c.

LONDON:
THOMAS NELSON, PATERNOSTER ROW;
AND EDINBURGH.

MDCCLL

203. d. 79.



PREFACE.

THE celebrity which Baron Humboldt enjoys, and which he has earned by a life of laborious investigation and perilous enterprise, renders his name familiar to every person whose attention has been drawn to political statistics or natural philosophy. In the estimation of the learned no author of the present day occupies a higher place among those who have enlarged the boundaries of human knowledge. To every one accordingly whose aim is the general cultivation of the mental faculties, his works are recommended by the splendid pictures of scenery which they contain, the diversified information which they afford respecting objects of universal interest, and the graceful attractions with which he has succeeded in investing the majesty of science.

These considerations have induced the Publishers to offer a condensed account of his Travels and Researches, such as, without excluding subjects even of laboured investigation, might yet chiefly embrace those which are best suited to the purposes of the general reader. The public taste has of late years gradually inclined towards objects of useful knowledge,—works of imagination have in a great measure given place to those occupied with descriptions of nature, physical or moral,—and the phenomena of the material world now afford entertainment to many who in former times would have sought for it at a different source. Romantic incidents, perilous adventures, the struggles of conflicting armies,

and vivid delineations of national manners and individual character, naturally excite a lively interest in every bosom, whatever may be the age or sex ; but, surely, the great facts of creative power and wisdom, as exhibited in regions of the globe of which they have no personal knowledge, are not less calculated to fix the attention of all reflecting minds. The magnificent vegetation of the tropical regions, displaying forests of gigantic trees, interspersed with the varied foliage of innumerable shrubs, and adorned with festoons of climbing and odoriferous plants ; the elevated table-lands of the Andes, crowned by volcanic cones, whose summits shoot high into the region of perennial snow ; the earthquakes that have desolated populous and fertile countries ; the vast expanse of the Atlantic Ocean, with its circling currents ; and the varied aspect of the heavens in those distant lands,—are subjects suited to the taste of every individual who is capable of contemplating the wonderful machinery of the universe.

It is unnecessary here to present an analysis of the labours of the illustrious philosopher whose footsteps are traced in this volume. Suffice it to observe, that some notices respecting his early life introduce the reader to an acquaintance with his character and motives, as the adventurous traveller, who, crossing the Atlantic, traversed the ridges and plains of Venezuela, ascended the Orinoco to its junction with the Amazon, sailed down the former river to the capital of Guiana, and after examining the Island of Cuba mounted by the valley of the Magdalena to the elevated platforms of the Andes, explored the majestic solitudes of the great cordilleras of Quito, navigated the margin of the Pacific Ocean, and wandered over the extensive and interesting provinces of New Spain, whence he made his way back by the

United States to Europe. The publication of the important results of this journey was not completed when he undertook another to Asiatic Russia and the confines of China, from which he has but lately returned.

From the various works which he has given to the world have been derived the chief materials of this narrative; and, when additional particulars were wanted, application was made to M. de Humboldt himself, who kindly pointed out the sources whence the desired information might be obtained. The life of a man of letters, he justly observed, ought to be sought for in his books; and for this reason little has been said respecting his occupations during the intervals of repose which have succeeded his perilous journeys.

It is only necessary further to apprise the reader, that the several measurements, the indications of the thermometer, and the value of articles of industry or commerce, which in the original volumes are expressed according to French, Spanish, and Russian usage, have been reduced to English equivalents.

Finally, the Publishers, confident that this abridged account of the travels of Humboldt will prove beneficial in diffusing a knowledge of the researches of that eminent naturalist, and in leading to the study of those phenomena which present themselves daily to the eye, send it forth with a hope that its reception will be as favourable and extensive as that bestowed upon its predecessors.

EDINBURGH, *October 1832.*

THIS edition of Professor Macgillivray's valuable narrative of the journey and researches of Baron Humboldt, is now extended so as to embrace his more recent labours, and to include his celebrated journey to the Ural Mountains, and his explora-

tion of the Altaian range, and the Caspian Sea. It also includes a sketch of the profound philosophical speculations suggested by the phenomena observed in the Asiatic continent, and published to the world both in his "Central Asia," and his more recent "Kosmos."

Extended as this work now is by such necessary and valuable additions, the publisher confidently anticipates for it a still more favourable reception, and extended popularity, than it commanded in its original form.

EDINBURGH, *June 1851.*

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THE
TRAVELS AND RESEARCHES
OF
BARON HUMBOLDT.

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Introduction.

Birth and Education of Humboldt.—His early Occupations.—He resolves to visit Africa.—Is disappointed in his Views, and goes to Madrid, where he is introduced to the King, and obtains permission to visit the Spanish Colonies.—Observations made on the Journey through Spain.—Geological Constitution of the Country between Madrid and Corunna.—Climate.—Ancient Submersion of the Shores of the Mediterranean.—Reception at Corunna, and Preparations for the Voyage to South America.

WITH the name of Humboldt we associate all that is interesting in the physical sciences. No traveller who has visited remote regions of the globe, for the purpose of observing the varied phenomena of nature, has added so much to our stock of positive knowledge. While the navigator has explored the coasts of unknown lands, discovered islands and shores, marked the depths of the sea, estimated the force of currents, and noted the more obvious traits in the aspect of the countries at which he has touched; while the zoologist has investigated the multiplied forms of animal life, the botanist the diversified vegetation, the geologist the structure and relations of the rocky masses of which the exterior of the earth is composed; and while each has thus contributed

CHAP. I.
Scientific
Associations.

CHAP. I
—
Universal
knowledge.

to the illustration of the wonderful constitution of our planet, the distinguished traveller whose discoveries form the subject of this volume stands alone, as uniting in himself a knowledge of all these sciences. Geography, meteorology, magnetism, the distribution of heat, the various departments of natural history, together with the affinities of races and languages, the history of nations, the political constitution of countries, statistics, commerce, and agriculture,—all have received accumulated and valuable additions from the exercise of his rare talents. The narrative of no traveller therefore could be more interesting to the man of varied information. But as from a work like that of which the present volume constitutes a part subjects strictly scientific must be excluded, unless when they can be treated in a manner intelligible to the public at large, it may here be stated, that many of the investigations, of which we present the results, must be traced in the voluminous works which the author himself has published. At the same time enough will be given to gratify the scientific reader; and while the narrative of personal adventure, the phenomena of the physical world, the condition of societies, and the numerous other subjects discussed, will afford amusement and instruction, let it be remembered, that truths faithfully extracted from the book of nature are alone calculated to enlarge the sphere of mental vision; and that, while fanciful description is more apt to mislead than to direct the footsteps of the student, there is reflected from the actual examination of the material universe a light which never fails to conduct the mind at once to sure knowledge and to pious sentiment.

Plan of the
work.

Birth of the
author

Frederick Henry Alexander Von Humboldt was born at Berlin on the 14th of September 1769. He received his academic education at Göttingen and Frankfurt on the Oder. In 1790 he visited Holland and England in company with Messrs George Forster and Van Geuns, and in the same year published his first work, entitled "Observations on the Basalts of the Rhine." In 1791 he went to Freyberg to receive the instructions of the

celebrated Werner, the founder of geological science. CHAP. I.
 The results of some of his observations in the mines of that district were published in 1793, under the title of *Specimen Floræ Freibergensis Subterraneæ*.

Having been appointed assessor of the Council of Assessor-ship of council of mines.
 Mines at Berlin in 1792, and afterwards director-general of the mines of the principalities of Baireuth and Anspach in Franconia, he directed his efforts to the formation of public establishments in these districts; and in 1795, he visited part of Italy and Switzerland. His active and comprehensive mind engaged in the study of all the physical sciences; but the discoveries of Galvani seem at this period to have more particularly attracted his attention. The results of his experiments on animal electricity were published in 1796, with notes by Professor Blumenbach. In 1795 he had gone to Vienna, Visit to Vienna. where he remained some time, ardently engaged in the study of a fine collection of exotic plants in that city. He travelled through several cantons of Salzburg and Styria with the celebrated Von Buch, but was prevented by the war which then raged in Italy from extending his journey to that country, whither he was anxious to proceed for the purpose of examining the volcanic districts of Naples and Sicily. Accompanied by his To Paris. brother William Von Humboldt and Mr Fischer, he then visited Paris, where he formed an acquaintance with M. Aimé Bonpland, a pupil of the school of Medicine and Garden of Plants, who afterwards becoming his associate in travel, has greatly distinguished himself by his numerous discoveries in botany.

Humboldt, from his earliest youth, had cherished an Desire to travel. ardent desire to travel into distant regions little known to Europeans, and, having at the age of eighteen resolved to visit the New Continent, he prepared himself by examining some of the most interesting parts of Europe, that he might be enabled to compare the geological structure of these two portions of the globe, and acquire a practical acquaintance with the instruments best adapted for aiding him in his observations. For-

CHAP. I. tunate in possessing ample pecuniary resources, he did not experience the privations which have disconcerted the plans and retarded the progress of many eminent individuals; but, not the less subject to unforeseen vicissitudes, he had to undergo several disappointments that thwarted the schemes which, like all men of ardent mind, he had indulged himself in forming. Meeting with a person passionately fond of the fine arts, and anxious to visit Upper Egypt, he resolved to accompany him to that interesting country; but political events interfered and forced him to abandon the project. The knowledge of the monuments of the more ancient nations of the Old World, which he acquired at this period, was subsequently of great use to him in his researches in the New Continent. An expedition of discovery to the southern hemisphere under the direction of Captain Baudin, then preparing in France, and with which M.M. Michaux and Bonpland were to be associated as naturalists, held out to him the hope of gratifying his desire of exploring unknown regions. But the war which broke out in Germany and Italy compelled the government to withdraw the funds allotted to this enterprise. Becoming acquainted with a Swedish consul who happened to pass through Paris with the view of embarking at Marseilles on a mission to Algiers, he resolved to embrace the opportunity thus offered of visiting Africa, in order to examine the lofty chain of mountains in the empire of Morocco, and ultimately to join the body of scientific men attached to the French army in Egypt. Accompanied by his friend Bonpland, he therefore betook himself to Marseilles, where he waited for two months the arrival of the frigate which was to convey the consul to his destination. At length, learning that this vessel had been injured by a storm, he resolved to pass the winter in Spain, in hopes of finding another the following spring.

On his way to Madrid, he determined the geographical position of several important parts, and ascertained the height of the central plain of Castile. In March 1799

Pecuniary resources.

Proposed visit to Egypt.

Interference with his plans.

Visit to Madrid.

he was presented at the court of Aranjuez, and graciously received by the king, to whom he explained the motives which induced him to undertake a voyage to the New Continent. Being seconded in his application by the representations of an enlightened minister, Don Mariano Luis de Urquijo, he to his great joy obtained leave to visit and explore, without impediment or restriction, all the Spanish territories in America. The impatience of the travellers to take advantage of the permission thus granted did not allow them to bestow much time upon preparations; and about the middle of May they left Madrid, crossed part of Old Castile, Leon, and Galicia, and betook themselves to Corunna, whence they were to sail for the island of Cuba.

CHAP. I.
Plan of
visit to
America.

According to the observations made by our travellers, the interior of Spain consists of an elevated table-land, formed of secondary deposits,—sandstone, gypsum, rock-salt, and Jura limestone. The climate of the Castiles is much colder than that of Toulon and Genoa, its mean temperature scarcely rising to 59° of Fahrenheit's thermometer. The central plain is surrounded by a low and narrow belt, in several parts of which the fan-palm, the date, the sugar-cane, the banana, and many plants common to Spain and the north of Africa, vegetate, without suffering from the severity of the winter. In the space included between the parallels of thirty-six and forty degrees of north latitude the mean temperature ranges from 62° to 68° Fahrenheit, and by a concurrence of favourable circumstances this section has become the principal seat of industry and intellectual cultivation.

Observations
in Spain.

Ascending from the shores of the Mediterranean, towards the elevated plains of La Mancha and the Castiles, one imagines that he sees far inland, in the extended precipices, the ancient coast of the Peninsula,—a circumstance which brings to mind the traditions of the Samothracians and certain historical testimonies, according to which the bursting of the waters through the

Plain of La
Mancha.

CHAP. I. Dardanelles, while it enlarged the basin of the Mediterranean, overwhelmed the southern part of Europe. The high central plain just described would, it may be presumed, resist the effects of the inundation until the escape of the waters by the strait formed between the Pillars of Hercules had gradually lowered the level of the Mediterranean, and thereby once more laid bare Upper Egypt on the one hand, and on the other the fertile valleys of Tarragon, Valentia, and Murcia.

Geological traditions.

Spanish mountain chains.

From Astorga to Corunna the mountains gradually rise, the secondary strata disappear by degrees, and the transition-rocks which succeed announce the proximity of primitive formations. Large mountains of graywacke and graywacke-slate present themselves. In the vicinity of the latter town are granitic summits which extend to Cape Ortegal, and which might seem, with those of Brittany and Cornwall, to have once formed a chain of mountains that has been broken up and submersed. This rock is characterized by large and beautiful crystals of felspar, and contains tin-ore, which is worked with much labour and little profit by the Galicians.

Blockade of Corunna.

On arriving at Corunna, they found the port blockaded by the English, for the purpose of interrupting the communication between the mother-country and the American colonies. The principal secretary of state had recommended them to Don Rafael Clavigo, recently appointed director-general of the maritime posts, who neglected nothing that could render their residence agreeable, and advised them to embark on board the corvette Pizarro bound for Havannah and Mexico. Instructions were given for the safe disposal of the instruments, and the captain was ordered to stop at Teneriffe so long as should be found necessary to enable the travellers to visit the port of Orotava and ascend the Peak.

Occupation at Corunna.

During the few days of their detention, they occupied themselves in preparing the plants which they had collected, and in making sundry observations. Crossing

to Ferrol they made some interesting experiments on the temperature of the sea and the decrease of heat in the successive strata of the water. The thermometer on the bank and near it was from $54\cdot5^{\circ}$ to $55\cdot9^{\circ}$, while in deep water it stood at 59° or $59\cdot5^{\circ}$, the air being 55° . The fact that the proximity of a sand-bank is indicated by a rapid descent of the temperature of the sea at its surface, is of great importance for the safety of navigators; for, although the use of the thermometer ought not to supersede that of the lead, variations of temperature indicative of danger may be perceived by it long before the vessel reaches the shoal. A heavy swell from the north-west rendered it impossible to continue their experiments. It was produced by a storm at sea, and obliged the English vessels to retire from the coast, — a circumstance which induced our travellers speedily to embark their instruments and baggage, although they were prevented from sailing by a high westerly wind that continued for several days.

CHAP. I.

Experiments
at Ferrol.

CHAPTER II.

Voyage from Corunna to Teneriffe.

Departure from Corunna.—Currents of the Atlantic Ocean.—Marine Animals.—Falling Stars.—Swallows.—Canary Islands.—Lancerotha.—Fucus vitifolius.—Causes of the Green Colour of Plants.—La Graciosa.—Stratified Basalt alternating with Marl.—Hyalite.—Quartz Sand.—Remarks on the Distance at which Mountains are visible at Sea, and the Causes by which it is modified.—Landing at Teneriffe.

CHAP. I.
Departure
from Co-
runna.

Evening
horizon at
sea.

THE wind having come round to the north-east, the Pizarro set sail on the afternoon of the 5th of June 1790, and after working out of the narrow passage passed the Tower of Hercules, or lighthouse of Corunna, at half-past six. Towards evening the wind increased, and the sea ran high. They directed their course to the north-west, for the purpose of avoiding the English frigates which were cruising off the coast, and about nine spied the fire of a fishing-hut at Sisarga, which was the last object they beheld in the west of Europe. As they advanced, the light mingled itself with the stars which rose on the horizon. "Our eyes," says Humboldt, "remained involuntarily fixed upon it. Such impressions do not fade from the memory of those who have undertaken long voyages at an age when the emotions of the heart are in full force. How many recollections are awakened in the imagination by a luminous point, which in the middle of a dark night, appearing at intervals above the agitated waves, marks the shore of one's native land!"

They were obliged to run under courses, and proceeded at the rate of ten knots, although the vessel was not a fast sailer. In the morning of the 6th she rolled so much that the fore topgallant-mast was carried away. On the 7th they were in the latitude of Cape Finisterre, belonging to the group of granitic rocks named the Sierra de Torinona, which is visible at sea to the distance of 59 miles. On the 8th at sunset, they discovered from the mast-head an English convoy; and to avoid them they altered their course during the night. On the 9th they began to feel the effect of the great current which flows from the Azores towards the Straits of Gibraltar and the Canaries. Its direction was at first east by south; but nearer the inlet it became due east, and its force was such as, between 37° and 30° lat., sometimes to carry the vessel, in twenty-four hours, from 21 to 30 miles eastward.

CHAP. II
Stormy
weather.

Between the tropics, especially from the coast of Senegal to the Caribbean Sea, there is a stream that always flows from east to west, and which is named the Equinoctial Current. Its mean rapidity may be estimated at ten or eleven miles in twenty-four hours. This movement of the waters, which is also observed in the Pacific Ocean, having a direction contrary to that of the earth's rotation, is supposed to be connected with those aerial currents from the poles, which, in the lower regions of the atmosphere, carry the cold air of the high latitudes towards the equator; and it is to the general impulse which these winds give to the surface of the ocean that the phenomenon in question is to be attributed.

Equinoctial
current.

supposed
cause.

This current carries the waters of the Atlantic towards the Mosquito and Honduras coasts, from which they move northwards, and passing into the Gulf of Mexico follow the bendings of the shore from Vera Cruz to the mouth of the Rio del Norte, and from thence to the mouths of the Mississippi and the shoals at

Its effect.

CHAP. II.
Course of
the current.

Change of
course.

Circuit of
the ocean
currents.

the southern extremity of Florida. After performing this circuit, it again directs itself northward, rushing with great impetuosity through the Straits of Bahama. At the end of these narrows, in the parallel of Cape Canaveral, the flow, which rushes onward like a torrent sometimes at the rate of five miles an hour, runs to the north-east. Its velocity diminishes and its breadth enlarges as it proceeds northward. Between Cayo Biscaino and the Bank of Bahama the width is only 52 miles, while in $28\frac{1}{2}^{\circ}$ of lat. it is 59; and in the parallel of Charlestown, opposite Cape Henlopen, it is from 138 to 173 miles, the rapidity being from three to five miles an hour where the stream is narrow, and only one mile as it advances towards the north. To the east of Boston and in the meridian of Halifax the current is nearly 276 miles broad. Here it suddenly turns towards the east; its western margin touching the extremity of the great bank of Newfoundland. From this to the Azores it continues to flow to the E. and E.S.E., still retaining part of the impulse which it had received nearly 3500 miles distant in the Straits of Florida. In the meridian of the Isles of Corvo and Flores, the most western of the Azores, it is not less than 552 miles in breadth. From the Azores it directs itself towards the Straits of Gibraltar, the island of Madeira, and the Canary Isles. To the south of Madeira, we can distinctly follow its motion to the S.E. and S.S.E. bearing on the shores of Africa, between Capes Cantin and Bojador. Cape Blanco, which, next to Cape Verd, farther to the south, is the most prominent part of that coast, seems again to influence the direction of the stream; and in this parallel it mixes with the great equinoctial current already described.

In this manner the waters of the Atlantic, between the parallels of 11° and 43° , are carried round in a continual whirlpool, which Humboldt calculates must take two years and ten months to perform its circuit of 13,118 miles. This great current is named the Gulf-

stream. Off the coast of Newfoundland a branch separates from it, and runs from S.W. to N.E. towards the coasts of Europe.

From Corunna to 36° of latitude, our travellers had scarcely seen any other animals than terns (or sea-swallows) and a few dolphins; but on the 11th June they entered a zone in which the whole sea was covered with a prodigious quantity of medusæ. The vessel was almost becalmed; but the mollusca advanced towards the south-east with a rapidity equal to four times that of the current, and continued to pass nearly three quarters of an hour, after which only a few scattered individuals were seen. Among these animals they recognised the *Medusa aurita* of Baster, the *M. pelagica* of Bosc, and a third approaching in its characters to the *M. hysocella*, which is distinguished by its yellowish-brown colour, and by having its tentacula longer than the body. Several of them were four inches in diameter, and the bright reflection from their bodies contrasted pleasantly with the azure tint of the sea.

On the morning of the 13th June, in lat. 34° 33', they observed large quantities of the *Dagysa notata*, of which several had been seen among the medusæ, and which consist of little transparent gelatinous sacs, extending to fourteen lines, with a diameter of two or three, and open at both ends. These cylinders are longitudinally agglutinated like the cells of a honeycomb, and form strings from six to eight inches in length. They observed, after it became dark, that none of the three species of medusa which they had collected emitted light unless they were slightly shaken. When a very irritable individual is placed on a tin plate, and the latter is struck with a piece of metal, the vibrations of the tin are sufficient to make the animal shine. Sometimes, on galvanizing medusæ, the phosphorescence appears at the moment when the chain closes, although the exciters are not in direct contact with the body of the subject. The fingers, after touching it, remain luminous for two or three minutes. Wood, on being

Medusa.

Dagysa
notata.Emission of
light.

CHAP. II. rubbed with a medusa, becomes luminous, and after the phosphorescence has ceased it may be rekindled by passing the dry hand over it ; but when the light is a second time extinguished it cannot be reproduced.

Phosphorescence produced.

Falling stars.

Between the island of Madeira and the coast of Africa, they were struck by the prodigious quantity of falling stars, which continued to increase as they advanced southward. These meteors, Humboldt remarks, are more common and more luminous in certain regions of the earth than in others. He has nowhere seen them more frequent than in the vicinity of the volcanoes of Quito, and in that part of the South Sea which washes the shores of Guatimala. According to the observations of Benzenberg and Brandes, many falling stars noticed in Europe were only 63,950 yards, or a little more than thirty-six miles high ; and one was measured, the elevation of which did not exceed 29,843 yards, or about seventeen miles. In warm climates, and especially between the tropics, they often leave behind them a train which remains luminous for twelve or fifteen seconds. At other times they seem to burst, and separate into a number of sparks. They are generally much lower than in the north of Europe. These meteors can be observed only when the sky is clear ; and perhaps none has ever been seen beneath a cloud. According to the observations of M. Arago, they usually follow the same course for several hours ; and in this case their direction is that of the wind.

Height of meteors.

Swallow.

When the voyagers were 138 miles to the east of Madeira, a common swallow (*Hirundo rustica*) perched on the topsail-yard, and was caught. What could induce a bird, asks our traveller, to fly so far at this season, and in calm weather ! In the expedition of Entrecasteaux, a swallow was also seen at the distance of 207 miles off Cape Blanco ; but this happened about the end of October, and M. Labillardiere imagined that it had newly arrived from Europe.

The Pizarro had been ordered to touch at Lancerota, one of the Canaries, to ascertain whether the harbour of

Santa Cruz in Teneriffe was blockaded by the English ; and on the 16th, in the afternoon, the seamen discovered land, which proved to be that island. As they advanced, they saw first the island of Forteventura, famous for the number of camels reared upon it, and soon after the smaller one of Lobos. Spending part of the night on deck, the naturalists viewed the volcanic summits of Lancerota illumined by the moon, and enjoyed the beautiful serenity of the atmosphere. After a time, great black clouds, rising behind the volcano, shrouded at intervals the moon and the constellation of Scorpio. They observed lights carried about on the shore, probably by fishermen, and having been employed occasionally during their passage in reading some of the old Spanish voyages, these moving fires recalled to their imagination those seen on the island of Guanahani on the memorable night of the discovery of the New World.

In passing through the archipelago of small islands, situated to the north of Lancerota, they were struck by the configuration of the coasts, which resembled the banks of the Rhine near Bonn. It is a remarkable circumstance, our author observes, that, while the forms of animals and plants exhibit the greatest diversity in different climates, the rocky masses present the same appearances in both hemispheres. In the Canary Isles, as in Auvergne, in the Mittelgebirge in Bohemia, in Mexico, and on the banks of the Ganges, the trap formation displays a symmetrical arrangement of the mountains, exhibiting truncated cones and graduated platforms.

The whole western part of Lancerota announces the character of a country recently deranged by volcanic action, every part being black, arid, and destitute of soil. The Abbé Viera relates, that in 1730 more than half of the island changed its appearance. The great volcano ravaged the most fertile and best cultivated district, and entirely destroyed nine villages. Its eruptions were preceded by an earthquake, and violent

CHAP. II.
Lancerota.

Configu-
tion of the
coasts.

Volcanic
traces.

CHAP. II

Continuation of shocks.

Ancien Canarians.

Marine plants.

Effects of light.

shocks continued to be felt for several years,—a phenomenon of rare occurrence, the agitation of the ground usually ceasing after a disengagement of lava or other volcanic products. The summit of the great crater, called the corona, is rounded, and its height has been accurately determined at 1867 feet. The island of Lancerota was formerly named Titeroigotra, and at the time of the arrival of the Spaniards its inhabitants were more civilized than the other Canarians, living in houses built of hewn stone, while the Guanches of Teneriffe resided in caves. There was then a very singular institution in the island. The women had several husbands, each of whom enjoyed the prerogative belonging to the head of a family in succession, the others remaining for the time in the capacity of common domestics.*

The occurrence, between the islands of Alegranza and Montana Clara, of a singular marine production with light-green leaves, which was brought up by the lead from a great depth, affords our author, in his narrative, an opportunity of stating some interesting facts respecting the colouring of plants. This seaweed, growing at the bottom of the ocean at a depth of 205 feet, had its vine-shaped leaves as green as those of our graminææ. According to Bouguer's experiments, light is weakened after a passage of 192 feet, in the proportion of 1 to 1477·8. At the depth of 205, this fucus could only have had light equal to half of that supplied by a candle seen at the distance of a foot. The germs of several of the liliacææ, the embryo of the mallows and other

* A similar practice is stated by Mr Fraser, in his "Journal of a Tour through the Himala Mountains," p. 206, to occur in several of the hill provinces of India. "It is usual all over the country for the future husband to purchase his wife from her parents; and the sum thus paid varies of course with the rank of the purchaser. The difficulty of raising this sum, and the alleged expense of maintaining women, may in part account for, if it cannot excuse, a most disgusting usage, which is universal over the country. Three or four or more brothers marry and cohabit with one woman, who is the wife of all. They are unable to raise the requisite sum individually, and thus club their shares, and buy this one common spouse."

1. *Chlorophyll a* (Chl *a*)

2. *Chlorophyll b* (Chl *b*)

3. *Carotenoids* (Carotenes and Xanthophylls)

4. *Phycocyanin* (Phycocyanin)

5. *Peridinin* (Peridinin)

6. *Algae* (Algae)

7. *Phaeophytin* (Phaeophytin)

8. *Phaeoerythrin* (Phaeoerythrin)

9. *Phaeo-*a** (Phaeo-*a*)

10. *Phaeo-*b** (Phaeo-*b*)

11. *Phaeo-*c** (Phaeo-*c*)

12. *Phaeo-*d** (Phaeo-*d*)

13. *Phaeo-*e** (Phaeo-*e*)

14. *Phaeo-*f** (Phaeo-*f*)

15. *Phaeo-*g** (Phaeo-*g*)

16. *Phaeo-*h** (Phaeo-*h*)

17. *Phaeo-*i** (Phaeo-*i*)

18. *Phaeo-*j** (Phaeo-*j*)

19. *Phaeo-*k** (Phaeo-*k*)

20. *Phaeo-*l** (Phaeo-*l*)

21. *Phaeo-*m** (Phaeo-*m*)

22. *Phaeo-*n** (Phaeo-*n*)

23. *Phaeo-*o** (Phaeo-*o*)

24. *Phaeo-*p** (Phaeo-*p*)

25. *Phaeo-*q** (Phaeo-*q*)

26. *Phaeo-*r** (Phaeo-*r*)

27. *Phaeo-*s** (Phaeo-*s*)

28. *Phaeo-*t** (Phaeo-*t*)

29. *Phaeo-*u** (Phaeo-*u*)

30. *Phaeo-*v** (Phaeo-*v*)

CHAP. II	show
Continuation of shocks.	mer usu volc call accr cerc
Ancien Canarians.	tim mor buil resi inst hus long rem don
Marine plants.	I Moi ligh fror an c ing the vine
Effects of light.	Acc afte 147 hav seen the

*
a To
ral o
try fo
the s
The
tainit
disgu
four c
wife c

and thus club their shares, and buy this one common spouse.'



BASALTIC ROCKS AND CASCADE OF REGLA



families, the branches of some subterranean plants, and vegetables transported into mines in which the air contains hydrogen or a great quantity of azote, become green without light. From these facts one might be induced to think that the existence of carburet of iron, which gives the green colour to the parenchyma of plants, is not dependent upon the presence of the solar rays only. Turner and many other botanists are of opinion that most of the seaweeds which we find floating on the ocean, and which in certain parts of the Atlantic present the appearance of a vast inundated meadow grow originally at the bottom of the sea, and are torn off by the waves. If this opinion be correct, the family of marine algæ presents great difficulties to those physiologists who persist in thinking that, in all cases, the absence of light must produce blanching.

CHAP. II.

Colour
without
light.Marine
algæ.

The captain, having mistaken a basaltic rock for a castle, saluted it, and sent one of the officers to inquire if the English were cruising in those parts. Our travellers took advantage of the boat to examine the land, which they had regarded as a prolongation of the coasts of Lancerota, but which turned out to be the small island of La Graciosa. "Nothing," says Humboldt, "can express the emotion a naturalist feels when for the first time he lands in a place which is not European. The attention is fixed upon so many objects, that one can hardly give an account of the impressions which he receives. At every step he imagines that he finds a new production; and, in the midst of this agitation, he often does not recognise those which are most common in our botanical gardens and museums." A fisherman, who, having been frightened by the firing, had fled from them, but whom the sailors overtook, stated that no vessels had been seen for several weeks. The rocks of this small island were of basalt and marl, destitute of trees or shrubs, in most places without a trace of soil, and but scantily crusted with lichens.

Opportune
mistake.Emotions on
landing.

The basalts are not columnar, but arranged in strata from 10 to 16 inches thick, and incline to the north-west

CHAP. II.

Basaltic
rocks.

at an angle of 80 degrees, alternating with marl. Some of these strata are compact, and contain large crystals of foliated olivine, often porous, with oblong cavities, from two to eight lines in diameter, which are coated with calcedony, and enclose fragments of compact basalt. The marl, which alternates more than a hundred times with the trap, is of a yellowish colour, extremely friable, very tenacious internally, and often divided into irregular prisms like those of basalt. It contains much lime, and effervesces strongly with muriatic acid. The travellers had not time to reach the summit of a hill, the base of which was formed of clay, with layers of basalt resting on it, precisely as in the Scheibenberger Huegel of Saxony. These rocks were covered with hyalite, of which they procured several fine specimens, leaving masses eight or ten inches square untouched.

Different
sands.

On the shore there were two kinds of sand, the one black and basaltic, the other white and quartz. Exposed to the sun's rays the thermometer rose in the former to 124·2°, and in the latter to 104°; while in the shade the temperature of the air was 81·8°, being 13·5° higher than the sea air. The quartz sand contains fragments of felspar. Pieces of granite have been observed at Teneriffe; and the island of Gomera, according to M. Broussonet, contains a nucleus of mica-slate. From these facts Humboldt infers, that, in the Canaries as in the Andes of Quito, in Auvergne, Greece, and most parts of the globe, the subterranean fires have made their way through primitive rocks.

Change of
wind.

Having re-embarked, they hoisted sail, and endeavoured to get out again by the strait which separates Aleganza from Montana Clara; but, the wind having fallen, the currents drove them close upon a rock marked in old charts by the name of Inferno, and in modern ones under that of Roca del Oeste,—a basaltic mass which has probably been raised by volcanic agency. Tacking during the night between Montana Clara and this islet, they were several times in great danger among shelves towards which they were drawn by the motion

of the water ; but the wind freshening in the morning, they succeeded in passing the channel, and sailed along the coasts of Lancerota, Lobos, and Forteventura.

CHAP. II.

Haziness
of atmo-
sphere.

The haziness of the atmosphere prevented them from seeing the Peak of Teneriffe during the whole of their passage from Lancerota ; but our traveller, in his narrative, states the following interesting circumstances relative to the distance at which mountains may be seen. If the height of the Peak, he says, is 12,182 feet, as indicated by the last trigonometrical measurement of Borda, its summit ought to be visible at the distance of 148 miles, supposing the eye at the level of the ocean, and the refraction equal to 0·079 of the distance. Navigators who frequent these latitudes find that the Peaks of Teneriffe and the Azores are sometimes observed at very great distances, while at other times they cannot be seen when the interval is considerably less, although the sky is clear. Such circumstances are of importance to navigators, who, in returning to Europe, impatiently wait for a sight of these mountains to rectify their longitude. The constitution of the atmosphere has a great influence on the visibility of distant objects, the transparency of the air being much increased when a certain quantity of water is uniformly diffused through it.

Peaks of
Teneriffe.

It is not surprising that the Peak of Teneriffe should be less frequently visible at a great distance than the tops of the Andes, not being like them invested with perpetual snow. The Sugar-loaf, which constitutes the summit of the former, no doubt reflects a great degree of light, on account of the white colour of the pumice with which it is covered ; but its height does not form a twenty-secondth part of the total elevation, and the sides of the volcano are coated with blocks of dark-coloured lava, or with luxuriant vegetation, the masses of which reflect little light, the leaves of the trees being separated by shadows of greater extent than the illuminated parts.

Causes of
its being
invisible.

Hence the Peak of Teneriffe is to be referred to the class of mountains which are seen at great distances only

CHAP. II. in what Bouguer calls a negative manner, or because
 Classification of mountains. they intercept the light transmitted from the extreme limits of the atmosphere; and we perceive their existence only by means of the difference of intensity that subsists between the light which surrounds them, and that reflected by the particles of air placed between the object of vision and the observer. In receding from Teneriffe, the Sugar-loaf is long seen in a positive manner, as it reflects a whitish light, and detaches itself clearly from the sky; but as this terminal cone is only 512 feet high, by 256 in breadth at its summit, it has been questioned whether it can be visible beyond the distance of 139 miles. If it be admitted that the mean breadth of the Sugar-loaf is $639\frac{1}{2}$ feet, it will still subtend, at the distance now named, an angle of more than three minutes, which is enough to render it visible; and were the height of the cone greatly to exceed its basis, the angle might be still less, and the mass yet make an impression on our organs; for it has been proved by micrometrical observations, that the limit of vision is one minute only when the dimensions of objects are the same in all directions.

The sugar-loaf.

Effect of change of position. As the visibility of an object, which detaches itself from the sky of a brown colour, depends on the quantities of light the eye meets in two lines, of which one ends at the mountain and the other is prolonged to the surface of the aerial ocean, it follows that the farther we remove from the object, the less also becomes the difference between the light of the surrounding atmosphere and that of the strata of air placed before the mountain. For this reason, when summits of low elevation begin to appear above the horizon, they are of a darker tint than those more elevated ones which we discover at very great distances. In like manner, the visibility of mountains which are only negatively perceived, does not depend solely upon the state of the low regions of the air, to which our meteorological observations are confined, but also upon its transparency and physical constitution in the most elevated parts; for the

image is more distinctly detached, the more intense the aerial light which comes from the limits of the atmosphere has originally been, or the less it has lost in its passage. This in a certain degree accounts for the circumstance, that the Peak is sometimes visible and sometimes invisible to navigators who are equally distant from it, when the state of the thermometer and hygrometer is precisely the same in the lower stratum of air. It is even probable, that the chance of perceiving this volcano would not be greater, were the cone equal, as in Vesuvius, to a fourth part of the whole height. The ashes spread upon its surface do not reflect light as the snow with which the summits of the Andes are covered, but, on the contrary, make the mountain, when seen from a great distance, become more obscurely detached, and assume a brown tint. They contribute, as it were, to equalize the portions of aerial light, the variable difference of which renders the object more or less distinctly visible. Bare calcareous mountains, summits covered with granitic sand, and the elevated savannahs of the Andes, which are of a bright yellow colour, are more clearly seen at small distances than objects that are perceived only in a negative manner; but theory points out a limit beyond which the latter are more distinctly detached from the azure vault of the sky.

CHAP. II.
Phenomena
of vision.

Reflected
light.

The aerial light projected on the tops of hills increases the visibility of those which are seen positively, but diminishes that of such as are detached with a brown colour. Bouguer, proceeding on theoretical data, has found that mountains which are seen negatively cannot be perceived at distances exceeding 121 miles; but experience goes against this conclusion. The Peak of Teneriffe has often been observed at the distance of 124, 131, and even 138 miles; and the summit of Mowna-Roa in the Sandwich Isles, which is probably 16,000 feet high, has been seen, at a period when it was destitute of snow, skirting the horizon from a distance of 183 miles. This is the most striking example yet

Projected
aerial light.

CHAP. II
 Island of
 Grand
 Canary.

known of the visibility of high land, and is the more remarkable that the object was negatively seen.

The atmosphere continuing hazy, the navigators did not discover the island of Grand Canary, notwithstanding its height, until the evening of the 18th June. On the following day they saw the point of Naga, but the Peak of Teneriffe still remained invisible. After repeatedly sounding, on account of the thickness of the mist, they anchored in the road of Santa Cruz, when, at the moment they began to salute the place, the fog instantaneously dispersed, and the Peak of Teyde, illuminated by the first rays of the sun, appeared in a break above the clouds. Our travellers betook themselves to the bow of the vessel to enjoy the majestic spectacle, when, at the very moment, four English ships were seen close astern. The anchor was immediately got up, and the Pizarro stood in as close as possible, to place herself under the protection of the fort.

Determin-
 ation of
 longitude.

While waiting the governor's permission to land, Humboldt employed the time in making observations for determining the longitude of the mole of Santa Cruz and the dip of the needle. Berthoud's chronometer gave $18^{\circ} 33' 10''$, the accuracy of which result, although differing from the longitude assigned by Cook and others, was afterwards confirmed by Krusenstern, who found that port $16^{\circ} 12' 45''$ west of Greenwich, and consequently $18^{\circ} 33' 0''$ west of Paris. The dip of the magnetic needle was $62^{\circ} 24'$, although it varied considerably in different places along the shore. After undergoing the fatigue of answering the numberless questions proposed by persons who visited them on board, our travellers were at length permitted to land.

CHAPTER III.

Island of Teneriffe.

Santa Cruz—Villa de la Laguna—Guanches—Present Inhabitants of Teneriffe—Climate—Scenery of the Coast—Orotava—Dragon-tree—Ascent of the Peak—Its Geological Character—Eruptions—Zones of Vegetation—Fires of St John.

SANTA CRUZ, the Anaza of the Guanches, which is a neat town with a population of 8000 persons, may be considered as a great caravansera situated on the road to America and India, and has consequently been often described. The recommendations of the court of Madrid procured for our travellers the most satisfactory reception in the Canaries. The captain-general gave permission to examine the island, and Colonel Armiaga, who commanded a regiment of infantry, extended his hospitality to them, and showed the most polite attention. In his garden they admired the banana, the papaw, and other plants cultivated in the open air, which they had before seen only in hothouses.

In the evening they made a botanical excursion towards the fort of Passo Alto, along the basaltic rocks which close the promontory of Naga, but had little success, as the drought and dust had in a manner destroyed the vegetation. The *Cacalia kleinia*, *Euphorbia canariensis*, and other succulent plants, which derive their nourishment more from the air than from the soil, reminded them by their aspect that the Canaries belong to Africa, and even to the most arid part of that continent.

CHAP. III.
Santa Cruz.

Botanical excursion.

CHAP. III The captain of the Pizarro having apprized them that, on account of the blockade by the English, they ought not to reckon upon a longer stay than four or five days, they hastened to set out for the port of Orotava, where they might find guides for the ascent of the Peak ; and on the 20th, before sunrise, they were on the way to Villa de la Laguna, which is 1684 feet above the sea. The road to this place is on the right of a torrent which in the rainy season forms beautiful falls. Near the town they met with some white camels employed in transporting merchandise. These animals, as well as horses, were introduced into the Canary Islands in the fifteenth century by the Norman conquerors, and were unknown to the Guanches. Camels are more abundant in Lancerota and Forteventura, which are nearer the continent, than at Teneriffe, where they very seldom propagate.

Causes of haste.

Camels and horses.

Geological features.

The hill on which the Villa de la Laguna stands belongs to the series of basaltic mountains, which forms a girdle around the Peak, and is independent of the newer volcanic rocks. The basalt on which the travellers walked was blackish-brown, compact, and partially decomposed. They found in it hornblende, olivine, and transparent pyroxene, with lamellar fracture, of an olive-green tint, and often crystallized in six-sided prisms. The rock of Laguna is not columnar, but divided into thin beds, inclined at an angle of from 30° to 40°, and has no appearance of having been formed by a current of lava from the Peak. Some arborescent *Euphorbiæ*, *Cacalia kleinia*, and *Cacti*, were the only plants observed on these parched acclivities. The mules slipped at every step on the inclined surfaces of the rock, although traces of an old road were observable, which, with the numerous other indications that occur in these colonies, afford evidence of the activity displayed by the Spanish nation in the sixteenth century.

Heat of climate.

The heat of Santa Cruz, which is suffocating, is in a great measure to be attributed to the reverberation of the rocks in its vicinity ; but as the travellers approached Laguna they became sensible of a very pleasant dimi-

nution of temperature. In fact, the perpetual coolness which exists here renders it a delightful residence. It is situated in a small plain, surrounded by gardens, and commanded by a hill crowned with the laurel, the myrtle, and the arbutus. The rain, in collecting, forms from time to time a kind of large pool or marsh, which has induced travellers to describe the capital of Teneriffe as situated on the margin of a lake. The town, which was deprived of its opulence in consequence of the port of Garachico having been destroyed by the lateral eruptions of the volcano, has only 9000 inhabitants, of which about 400 are monks. It is surrounded by numerous windmills for corn. Humboldt observes, that the cereal grasses were known to the original inhabitants, and that parched barley flour and goat's milk formed their principal meals. This food tends to show that they were connected with the nations of the Old Continent, perhaps even with those of the Caucasian race, and not with the inhabitants of the New World, who, previous to the arrival of the Europeans among them, had no knowledge of grain, milk, or cheese.

CHAP. III.

Laguna.

Corn wind-mills.

The Canary Islands were originally inhabited by a people famed for their tall stature, and known by the name of Guanches. They have now entirely disappeared under the oppression of a more powerful and more enlightened race, which, assuming the superiority supposed to be sanctioned by civilisation and the profession of the Christian faith, disposed of the natives in a manner little accordant with the character of a true follower of the cross. The archipelago of the Canaries was divided into small states hostile to each other; and in the fifteenth century, the Spaniards and Portuguese made voyages to these islands for slaves, as the Europeans have latterly been accustomed to do to the coast of Guinea. One Guancho then became the property of another, who sold him to the dealers; while many, rather than become slaves, killed their children and themselves. The natives had been greatly reduced in this manner, when Alonzo de Lugo completed their

Guanches.

Their enslavement.

- CHAP. III. subjugation. The residue of that unhappy people perished by a terrible pestilence in 1494, which was supposed to have originated from the bodies left exposed by the Spaniards after the battle of Laguna. At the present day, no individual of pure blood exists in these islands, where all that remains of the aborigines are certain mummies, reduced to an extraordinary degree of desiccation, and found in the sepulchral caverns which are cut in the rock on the eastern slope of the Peak. These skeletons contain remains of aromatic plants, especially the *Chenopodium ambrosioides*, and are often decorated with small laces, to which are suspended little cakes of baked earth.
- Destruction of the natives.
- Mummies.
- New race. The people who succeeded the Guanches were descended from the Spaniards and Normans. The present inhabitants are described by our author as being of a moral and religious character, but of a roving and enterprising disposition, and less industrious at home than abroad. The population in 1790 was 174,000. The produce of the several islands consists chiefly of wheat, barley, maize, potatoes, wine, a great variety of fruits, sugar, and other articles of food; but the lower orders are frequently obliged to have recourse to the roots of a species of fern. The principal objects of commerce are wine, brandy, archil (a kind of lichen used as a dye), and soda.
- Population.
- Climate. Teneriffe has been praised for the salubrity of its climate. The ground of the Canary Islands rises gradually to a great height, and presents, on a small scale, the temperature of every zone, from the intense heat of Africa to the cold of the Alpine regions; so that a person may have the benefit of whatever climate best suits his temperament or disease. A similar variety exists as to the vegetation; and no country seemed to our travellers more fitted to dissipate melancholy, and restore peace to an agitated mind, than Teneriffe and Madeira, where the natural beauty of the situation, and the salubrity of the air, conspire to quiet the anxieties of the spirit and invigorate the body, while the feelings

are not harassed by the revolting sight of slavery, which CHAP. III
exists in almost all the European colonies.

In winter the climate of Laguna is excessively foggy, ^{Winter} and the inhabitants often complain of cold, although ^{fogs} snow never falls. The lowest height at which it occurs annually in Teneriffe has not been ascertained; but it has been seen in a place lying above Esperanza de la Laguna, close to the town of that name, in the gardens of which the breadfruit-tree (*Artocarpus incisa*), introduced by M. Broussonet, has been naturalized. In connexion with this subject, Humboldt remarks, that in hot countries the plants are so vigorous that they can bear a greater degree of frost than might be expected, provided it be of short duration. The banana is cultivated in Cuba, in places where the thermometer sometimes descends to very near the freezing-point; and in Spain and Italy, orange and date trees do not perish, although the cold may be nearly four degrees below that point. Trees growing in a fertile soil are remarked by cultivators to be less delicate, and less affected by changes of temperature, than those planted in land that affords little nutriment.

From Laguna to the port of Orotava, and the western ^{Western} coast of Teneriffe, the route is at first over a hilly ^{coast} country covered by a black argillaceous soil. The subjacent rock is concealed by layers of ferruginous earth; but in some of the ravines are seen columnar basalts, with recent conglomerates, resembling volcanic tufas lying over them, which contain fragments of the former, and also, as is asserted, marine petrifications. This delightful country, of which travellers of all nations speak with enthusiasm, is entered by the valley of Tacoronte, and presents scenes of unrivalled beauty. The seashore is ornamented with palms of the date and ^{Palm trees.} cocoa species. Farther up, groups of musæ and dragon-trees present themselves. The declivities are covered with vines. Orange-trees, myrtles, and cypresses, surround the chapels that have been raised on the little hills. The lands are separated by enclosures formed of

- CHAP. III.** the agave and cactus. Multitudes of cryptogamic plants, especially ferns, cover the walls. In winter, while the volcano is wrapped in snow, there is continued spring in this beautiful district ; and in summer, towards evening, the sea-breezes diffuse a gentle coolness over it. From Tegueste and Tacoronte to the village of San Juan de la Rambla, the coast is cultivated like a garden, and might be compared to the neighbourhood of Capua or Valentia ; but the western part of Teneriffe is much more beautiful, on account of the proximity of the Peak, the sight of which has a most imposing effect, and excites the imagination to penetrate into the mysterious source of volcanic action. For thousands of years no light has been observed at the summit of the mountain, and yet enormous lateral eruptions, the last of which happened in 1798, prove the activity of a fire which is far from being extinct. There is, besides, something melancholy in the sight of a crater placed in the midst of a fertile and highly cultivated country.
- Plants.**
- Volcanic action.**
- Matanza and Vittoria.** Pursuing their course to the port of Orotava, the travellers passed the beautiful hamlets of Matanza and Vittoria (slaughter and victory),—names which occur together in all the Spanish colonies, and present a disagreeable contrast to the feelings of peace and quiet which these countries inspire. On their way they visited a botanic garden at Durasno, where they found M. Le Gros, the French vice-consul, who subsequently served as an excellent guide to the Peak. The idea of forming such an establishment at Teneriffe originated with the Marquis de Nava, who thought that the Canary Islands afford the most suitable place for naturalizing the plants of the East and West Indies, previous to their introduction to Europe. They arrived very late at the port, and next morning commenced their journey to the Peak, accompanied by M. Le Gros, M. Lalande, secretary of the French consulate at Santa Cruz, the English gardener of Durasno, and a number of guides.
- Botanic garden.**
- Orotava.** Orotava, the Taoro of the Guanches, is situated on a very steep declivity, and has a pleasant aspect when



Dragon-tree of Orotava.

viewed from a distance, although the houses, when seen at hand, have a gloomy appearance. One of the most remarkable objects in this place is the dragon-tree in the garden of M. Franqui, of which an engraving is here presented, and which our travellers found to be about 60 feet high, with a circumference of 48 feet near the roots. The trunk divides into a great number of branches, which rise in the form of a candelabrum, and are terminated by tufts of leaves. This tree is said to have been revered by the Guanches as the ash of Ephesus was by the Greeks; and in 1402, at the time of the first expedition of Bethencour, was as large and as hollow as our travellers found it. As the species is of very slow growth, the age of this individual must be great.

Leaving Orotava, they passed by a narrow and stony path through a beautiful wood of chestnuts to a place covered with brambles, laurels, and arborescent heaths,

CHAP. III.
 —
 Ascent of
 the peak.

where, under a solitary pine, known by the name of Pino del Dornajito, they procured a supply of water. From this place to the crater they continued to ascend without crossing a single valley, passing over several regions distinguished by their peculiar vegetation, and rested during part of the night in a very elevated position, where they suffered severely from the cold. About three in the morning they began to climb the Sugar-loaf, or small terminal cone, by the dull light of fir-torches, and examined a small subterranean glacier or cave, whence the towns below are supplied with ice throughout the summer.

Singular
 pheno-
 menon.

In the twilight they observed a phenomenon not unusual on high mountains,—a stratum of white clouds spread out beneath, concealing the face of the ocean, and presenting the appearance of a vast plain covered with snow. Soon afterwards another very curious sight occurred, namely, the semblance of small rockets thrown into the air, and which they at first imagined to be a certain indication of some new eruption of the great volcano of Lancerota. But the illusion soon ceased, and they found that the luminous points were only the images of stars magnified and refracted by the vapours. They remained motionless at intervals, then rose perpendicularly, descended sidewise, and returned to their original position. After three hours' march over an extremely rugged tract, the travellers reached a small plain called La Rambleta, from the centre of which rises the Piton or Sugar-loaf. The slope of this cone, covered with volcanic ashes and pumice, is so steep that it would have been almost impossible to reach the summit, had they not ascended by an old current of lava, which had in some measure resisted the action of the atmosphere.

Images of
 stars.

Edge of the
 crater.

On attaining the top of this steep, they found themselves on the edge of the crater, from which they descended to the bottom of the funnel or caldera, the greatest diameter of which at the mouth seemed to be 320 feet. There were no large openings in the crater ;

but aqueous vapours were emitted by some of the crevices, in which heat was perceptible. In fact, the volcano has not been active at the summit for thousands of years, its eruptions having been from the sides, and the depth of the crater is only about 106 feet. After examining the objects that presented themselves in this elevated spot, and enjoying the vast prospect, the travellers commenced their descent, and towards evening reached the port of Orotava.

CHAP. III.
Eruptions.

The Peak of Teneriffe forms a pyramidal mass having a circumference at the base of more than 115,110 yards, and a height of 12,176 feet.* Two-thirds of the mass are covered with vegetation, the remaining part being steril, and occupying about ten square leagues of surface. The cone is very small in proportion to the size of the mountain, it having a height of only 537 feet, or $\frac{1}{22}$ of the whole. The lower part of the island is composed of basalt and other igneous rocks of ancient formation, and is separated from the more recent lavas and the products of the present volcano by strata of tufa, puzzolana, and clay. The first that occur in ascending the Peak are of a black colour, altered by decomposition, and sometimes porous. Their basis is wacke, and has usually an irregular, but sometimes a conchoidal fracture. They are divided into very thin layers, and contain olivine, magnetic iron, and augite. On the first elevated plain, that of Retama, the basaltic deposits disappear beneath heaps of ashes and pumice. Beyond this are lavas,

Dimensions
of the peak.

Geological
features.

* Various measurements have been made of the height of the Peak of Teneriffe; but Humboldt, after enumerating fourteen, states that the following alone can be considered as deserving of confidence:

Borda's, by trigonometry,.....	1905 toises.
Borda's, by the barometer,.....	1976
Lamanou's, by the same,.....	1902
Cordier's, by the same,.....	1920

The average of these four observations makes the height 1926 toises; but if the barometric measurement of Borda be rejected, as liable to objections particularly stated by our author, the mean of the remaining measurement is 1909 toises, or 12,208 English feet. It is seen above, that the height adopted by Humboldt is 1904 toises, or 12,176 English feet.

CHAP. III.

Lavas.

with a basis of pitch-stone and obsidian, of a blackish-brown or deep olive-green colour, and containing crystals of felspar, which are seldom vitreous. In the middle of the Malpays or second platform are found, amongst the glassy kinds, blocks of greenish-gray clinkstone or porphyry-slate. Obsidian of several varieties is exceedingly abundant on the Peak, as well as pumice, the latter being generally of a white colour; and the crater contains an enormous quantity of sulphur.

Accounts of eruptions,

The oldest written testimony, in regard to the activity of the volcano, dates at the beginning of the sixteenth century, and is contained in the narrative of Aloysio Cadamusto, who landed in the Canaries in 1505. In 1558, 1646, and 1677, eruptions took place in the isle of Palma; and on the 31st December 1704, the Peak of Teneriffe exhibited a lateral burst, preceded by tremendous earthquakes. On the 5th of January 1705, another opening occurred, the lavas produced by which filled the whole valley of Fasnía. This aperture closed on the 13th of January; but on the 2d of February, a third formed in the Canada de Arafo, the stream from which divided into three currents. On the 5th May 1706, another eruption supervened, which destroyed the populous and opulent city of Garachico. In 1730, on the 1st September, the island of Lancerota was violently convulsed; and on the 9th June 1798, the Peak emitted a great quantity of matter, which continued to run three months and six days.

Zones of vegetation.

The island of Teneriffe presents five zones of vegetation, arranged in stages one above another, and occupying a perpendicular height of 3730 yards.

Vines.

1. The *Region of Vines* extends from the shores to an elevation varying from 430 to 640 yards, and is the only part carefully cultivated. It exhibits various species of arborescent Euphorbiæ, Mesembryanthema, the *Cacalia kleinia*, the *Dracæna*, and other plants, whose naked and tortuous trunks, succulent leaves, and bluish-green tints, constitute features distinctive of the vegetation of Africa. In this zone are raised the date-

tree, the plantain, the sugar-cane, the Indian-fig, the arum colocasia, the olive, the fruit-trees of Europe, the vine, and wheat. CHAP. III.

2. The *Region of Laurels* is that which forms the woody part of Teneriffe, where the surface of the ground is always verdant, being plentifully watered by springs. Four kinds of laurel, an oak, a wild olive, two species of iron-tree, the arbutus callicarpa, and other evergreens, adorn this zone. The trunks are covered by the ivy of the Canaries and various twining shrubs, and the woods are filled with numerous species of fern. The hypericum, and other showy plants, enrich with their beautiful flowers the verdant carpet of moss and grass. Laurels.

3. The *Region of Pines*, which commences at the height of 1920 yards, and has a breadth of 850, is characterized by a vast forest of trees, resembling the Scotch fir, intermixed with juniper. Pines.

4. The fourth zone is remarkable chiefly for the profusion of *retama*, a species of broom, which forms oases in the midst of a wide sea of ashes. It grows to the height of nine or ten feet, is ornamented with fragrant flowers, and furnishes food to the goats, which have run wild on the Peak from time immemorial.

5. The fifth zone is the *Region of the Grasses*, in which some species of these supply a scanty covering to the heaps of pumice, obsidian, and lava. A few cryptogamic plants are observed higher; but the summit is entirely destitute of vegetation.* Grasses.

* The above is the account of the Peak of Teneriffe given in his text, by Humboldt after M. Broussonnet; but in a later portion of his work he substitutes the following divisions of M. Von Buch, which he considers as more correct:—This illustrious geologist distinguishes, 1st, The Region of African forms 0—416 yards; 2d, The Region of Vines and Cereal Plants 416—916 yards; 3d, The Region of Laurels 916—1450 yards; 4th, The Region of Pines 1450—2090 yards; 5th, The Region of the Retama 2090—3687 yards. This last plant is only found in Teneriffe, none of the mountains in the other islands rising within its inferior limit (2130 yards) excepting Palma, and the summit of its Peak is only barren and naked rocks. The granineous plants are very rare, and do not form a particular zone.

CHAP. III. Thus the whole island may be considered as a forest of laurels, arbutuses, and pines, of which the external margin only has been in some measure cleared, while the central part consists of a rocky and sterile soil, unfit even for pasturage.

General character of the island.

Eve of St. John.

The following day was passed by our travellers in visiting the neighbourhood of Orotava, and enjoying an agreeable company at Mr Cologan's. On the eve of St John, they were present at a pastoral fête in the garden of Mr Little, who had reduced to cultivation a hill covered with volcanic substances, from which there is a magnificent view of the Peak, the villages along the coast, and the isle of Palma. Early in the evening, the volcano suddenly exhibited a most extraordinary spectacle, the shepherds having, in conformity to ancient custom, lighted the fires of St John; the scattered masses of which, with the columns of smoke driven by the wind, formed a fine contrast to the deep verdure of the woods that covered the sides of the mountain, while the silence of nature was broken at intervals by the shouts of joy which came from afar.

CHAPTER IV.

Passage from Teneriffe to Cumana.

Departure from Santa Cruz—Floating Seaweeds—Flying-fish—Stars—Malignant Fever—Island of Tobago—Death of a Passenger—Island of Coche—Port of Cumana—Observations made during the Voyage; Temperature of the Air; Temperature of the Sea; Hygrometrical State of the Air; Colour of the Sky and Ocean.

HAVING sailed from Santa Cruz on the evening of the 25th of June, with a strong wind from the north-east, our travellers soon lost sight of the Canary Islands, the mountains of which were covered with reddish vapour, the Peak alone appearing at intervals in the breaks. The passage from Teneriffe to Cumana was performed in twenty days, the distance being 3106 miles.

The wind gradually subsided as they retired from the African coast. Short calms of several hours occasionally took place, which were regularly interrupted by slight squalls, accompanied by masses of dark clouds, emitting a few large drops of rain, but without thunder. To the north of the Cape Verd Islands they met with large patches of floating seaweed (*Fucus natans*), which grows on submarine rocks, from the equator to forty degrees of latitude on either side. These scattered plants, however, must not be confounded with the vast beds, said by Columbus to resemble extensive meadows, and which inspired with terror the crew of the Santa Maria. From a comparison of numerous journals, it appears that there are two such fields of seaweed in the

CHAP. IV.
Leaving
Santa Cruz.

Changes of
wind.

Floating
sea-weed.

CHAP. IV. Atlantic. The largest occurs a little to the west of the meridian of Fayal, one of the Azores, between 25° and 36° of latitude. The temperature of the ocean there is between 60·8° and 68°; and the north-west winds, which blow sometimes with impetuosity, drive floating islands of those weeds into low latitudes, as far as the parallels of 24° and even 20°. Vessels returning to Europe from Monte Video, or the Cape of Good Hope, pass through this marine meadow, which the Spanish pilots consider as lying half-way between the West Indies and the Canaries. The other section is not so well known, and occupies a smaller space between lat. 22° and 26° of N., two hundred and seventy-six miles eastward of the Bahama Islands.

Fields of
sea weed.

Floating
fuci.

Although a species of seaweed, the *Laminaria pyrifera* of Lamouroux, has been observed with stems 850 feet in length, and although the growth of these plants is exceedingly rapid, it is yet certain that in those seas the fuci are not fixed to the bottom, but float in detached parcels at the surface. In this state vegetation, it is obvious, cannot continue longer than in the branch of a tree separated from the trunk; and it may therefore be supposed, that floating masses of these weeds occurring for ages in the same position owe their origin to submarine rocks, which continually supply what has been carried off by the equinoctial currents. But the causes by which these plants are detached are not yet sufficiently known, although the author just named has shown that fuci in general separate with great facility after the period of fructification.

Flying-fish.

Beyond 22° of latitude they found the surface of the sea covered with flying-fish (*Exocetus volitans*), which sprung into the air to a height of twelve, fifteen, and even eighteen feet, and sometimes fell on the deck. The great size of the swimming-bladder in these animals, being more than one-half of their body, as well as that of the pectoral fins, enable them to traverse in the air a space of twenty-four feet horizontal distance before falling again into the water. They are incessantly

pursued by dolphins while under the surface, and when flying are attacked by frigate-birds and other predatory species. Yet it does not seem that they leap into the atmosphere merely to avoid their enemies; for, like swallows, they move by thousands in a right line, and always in a direction opposite to that of the waves. The air contained in the swimming-bladder had been supposed to be pure oxygen; but Humboldt found it to consist of ninety-four parts of azote, four of oxygen, and two of carbonic acid.

On the 1st of July they met with the wreck of a vessel, and on the 3d and 4th crossed that part of the ocean where the charts indicate the bank of the Maal-Stroom, which, however, is of very doubtful existence. As they approached this imaginary whirlpool they observed no other motion in the waters than that produced by a current bearing to the north-west.

From the time when they entered the torrid zone (the 27th June) they never ceased to admire the nocturnal beauty of the southern sky, which gradually disclosed new constellations to their view. "One experiences an indescribable sensation," says Humboldt, "when, as he approaches the equator, and especially in passing from the one hemisphere to the other, he sees the stars with which he has been familiar from infancy gradually approach the horizon and finally disappear. Nothing impresses more vividly on the mind of the traveller the vast distance to which he has been removed from his native country than the sight of a new firmament. The grouping of the larger stars, the scattered nebulae rivalling in lustre the milky-way, and spaces remarkable for their extreme darkness, give the southern heavens a peculiar aspect. The sight even strikes the imagination of those who, although ignorant of astronomy, find pleasure in contemplating the celestial vault, as one admires a fine landscape or a majestic site. Without being a botanist, the traveller knows the torrid zone by the mere sight of its vegetation; and without the possession of astronomical knowledge, perceives that

CHAP. IV.

Dolphins and frigate birds.

Wreck of a vessel.

Nocturnal beauty of sky.

Aspect of the southern heavens.

CHAP. IV. he is not in Europe, when he sees rising in the horizon the great constellation of the Ship, or the phosphorescent clouds of Magellan. In the equinoctial regions, the earth, the sky, and all their garniture, assume an exotic character."

Intertropical
voyage.

The intertropical seas being usually smooth, and the vessel being impelled by the gentle breezes of the trade-wind, the passage from the Cape Verd Islands to Cumana was as pleasant as could be desired; but as they approached the West Indies a malignant fever disclosed itself on board. The ship was very much encumbered between decks, and from the time they passed the tropic the thermometer stood from 93° to 96·8°. Two sailors, several passengers, two negroes from the coast of Guinea, and a mulatto child, were attacked. An ignorant Galician surgeon ordered bleedings, to obviate the "heat and corruption of the blood;" but little exertion had been made in attempting to diminish the danger of infection, and there was not an ounce of bark on board. A sailor, who had been on the point of expiring, recovered his health in a singular manner. His hammock having been so hung that the sacrament could not be administered to him, he was removed to an airy place near the hatchway, and left there, his death being expected every moment. The transition from a hot and stagnant to a fresher and purer atmosphere gradually restored him, and his recovery furnished the doctor with an additional proof of the necessity of bleeding and evacuation,—a treatment of which the fatal effects soon became perceptible.

Malignant
fever.

Curative
means.

Rough
weather.

On the 13th, early in the morning, very high land was seen. The wind blew hard, the sea was rough, large drops of rain fell at intervals, and there was every appearance of stormy weather. Considerable doubt existed as to the latitude and longitude, which was however, removed by observations made by our travellers, and the appearance of the island of Tobago. This little island is a heap of rocks, the dazzling whiteness of which forms an agreeable contrast with the

verdure of the scattered tufts of trees upon it. The mountains are covered with very tall opuntia, which alone are enough to apprise the navigator that he has arrived on an American coast. CHAP. IV.
Island of Tobago.

After doubling the north cape of Tobago and the point of St Giles, they discovered from the mast-head what they regarded as a hostile squadron; which however turned out to be only a group of rocks. Crossing the shoal which joins the former island to Grenada, they found that, although the colour of the sea was not visibly changed, the thermometer indicated a temperature several degrees lower than that of the neighbouring parts. The wind diminished after sunset, and the clouds dispersed as the moon reached the zenith. Numerous falling-stars were seen on this and the following nights. Optical deception.

On the 14th, at sunrise, they were in sight of the Bocca del Drago, and distinguished the island of Chacachacarro. When 17 miles distant from the coast, they experienced, near Punta de la Baca, the effect of a current which drew the ship southward. Heaving the lead, they found from 230 to 275 feet, with a bottom of very fine green clay,—a depth much less than, according to Dampier's rule, might have been expected in the vicinity of a shore formed of very elevated and perpendicular mountains. Bocca del Drago.

The disease which had broken out on board the Pizarro made rapid progress from the time they approached the coast. The thermometer kept steady at night between 71·6° and 73·4°, and during the day rose to between 75·2° and 80·6°. The determination to the head, the extreme dryness of the skin, the prostration of strength, and all the other symptoms became more alarming: but it was hoped that the sick would recover as soon as they were landed on the island of Margarita or at the port of Cumana, both celebrated for their great salubrity. This hope, however, was not entirely realized, for one of the passengers fell a victim to the distemper. He was an Asturian, nineteen years of age, Progress of disease.

CHAP. IV. the only son of a poor widow. Various circumstances combined to render the death of this young man affecting. He was of an exceedingly gentle disposition, bore the marks of great sensibility, and had left his native land against his inclination, with the view of earning an independence and assisting his reluctant mother, under the protection of a rich relation, who resided in the island of Cuba. From the commencement of his illness he had fallen into a lethargic state, interrupted by accessions of delirium, and on the third day expired. Another Asturian, who was still younger, did not leave the bed of his dying friend for a moment, and yet escaped the disease. He had intended to accompany his countryman to Cuba, to be introduced by him to the house of his relative, on whom all their hopes rested; and it was distressing to see his deep sorrow, and to hear him curse the fatal counsels which had thrown him into a foreign climate, where he found himself alone and destitute.

Death of a passenger

Fidelity of attachment.

Melancholy impressions

Death-bell.

“We were assembled on the deck,” says our eloquent author, “absorbed in melancholy reflections. It was no longer doubtful that the fever which prevailed on board had of late assumed a fatal character. Our eyes were fixed on a mountainous and desert coast, on which the moon shone at intervals through the clouds. The sea, gently agitated, glowed with a feeble phosphoric light. No sound came on the ear save the monotonous cry of some large sea-birds that seemed to be seeking the shore. A deep calm reigned in these solitary places; but this calm of external nature accorded ill with the painful feelings which agitated us. About eight the death-bell was slowly tolled. At this doleful signal the sailors ceased from their work, and threw themselves on their knees to offer up a short prayer,—an affecting ceremony, which, while it recalls the times when the primitive Christians considered themselves as members of the same family, seems to unite men by the feeling of a common evil. In the course of the night the body of the Asturian was brought upon deck, and

the priest prevailed upon them not to throw it into the sea until after sunrise, in order that he might render to it the last rites, in conformity to the practice of the Romish church. There was not an individual on board who did not feel for the fate of this young man, whom we had seen a few days before full of cheerfulness and health."

CHAP. IV.
Funeral
rites.

The passengers who had not been affected by the disease resolved to leave the ship at the first place where she should touch, and there wait the arrival of another packet to convey them to Cuba and Mexico. Our travellers also thought it prudent to land at Cumana, more especially as they wished not to visit New Spain until they had remained for some time on the coasts of Venezuela and Paria, and examined the beautiful plants of which Bosc and Bredemeyer collected specimens on their voyage to Terra Firma, and which Humboldt had seen in the gardens of Schönbrunn and Vienna. This resolution had a happy influence upon the direction of their journey, as will subsequently be seen, and perhaps was the occasion of securing for them the health which they enjoyed during a long residence in the equinoctial regions. They were by this means fortunate enough to pass the time when a European recently landed runs the greatest danger of being affected by the yellow fever, in the hot but dry and salubrious climate of Cumana.

Quitting
the ship.

Fortunate
results.

As the coast of Paria stretches to the west, in the form of perpendicular cliffs of no great height, they were long without perceiving the bold shores of the island of Margarita, where they intended to stop for the purpose of obtaining information respecting the English cruisers. Toward eleven in the morning of the 15th, they observed a very low islet covered with sand, and destitute of any trace of culture or habitation. Cactuses rose here and there, from a scanty soil which seemed to have an undulating motion, in consequence of the extraordinary refraction the solar rays undergo in passing through the strata of air in contact with a strongly-

Coast of
Paria.

Vegetation.

- CHAP. IV.** heated surface. The deserts and sandy shores of all countries present this appearance. The aspect of this place not corresponding with the ideas which they had formed of the island of Margarita, and the greatest perplexity existing as to their position and course, they cast anchor in shallow water, and were visited by some Guayquerias in two canoes, constructed each of the single trunk of a tree. These Indians, who were of a coppery colour and very tall, informed them that they had kept too far south, that the low islet near which they were at anchor was the island of Coche, and that Spanish vessels coming from Europe usually passed to the northward of it. The master of one of the canoes offered to remain on board as coasting pilot, and towards evening the captain set sail.
- Perplexity of the voyagers.**
- Native Indians.** On the 16th they beheld a verdant coast of picturesque appearance ; the mountains of New Andalusia bounded the southern horizon, and the city of Cumana and its castle appeared among groups of trees. They anchored in the port about nine in the morning, when the sick crawled on deck to enjoy the sight. The river was bordered with cocoa-trees more than sixty feet high,—the plain was covered with tufts of cassias, capers, and arborescent mimosas, while the pinnated leaves of the palms were conspicuous on the azure of a sky unsullied by the least trace of vapour. A dazzling light was spread along the white hills clothed with cylindrical cactuses, and over the smooth sea, the shores of which were peopled by pelicans, egrets, and flamingoes. Every thing announced the magnificence of nature in the equinoctial regions.
- Cumana.**
- Plants and animals.** Before accompanying our learned friends to the city of Cumana, we may here take a glance of the physical observations made by them during the voyage, and which refer to the temperature of the air and sea, and other subjects of general interest.
- Temperature.** *Temperature of the Air.*—In the basin of the northern Atlantic Ocean, between the coasts of Europe, Africa, and America, the temperature of the atmosphere exhi-

bits a very slow increase. From Corunna to the Canary Islands, the thermometer, observed at noon, and in the shade, gradually rose from 50° to 64° , and from Teneriffe to Cumana from 64° to 77° . The maximum of heat observed during the voyage did not exceed 79.9° . CHAP. IV

The extreme slowness with which the temperature increases during a voyage from Spain to South America is highly favourable to the health of Europeans, as it gradually prepares them for the intense heat which they have to experience. It is in a great measure attributable to the evaporation of the water, augmented by the motion of the air and waves, together with the property possessed by transparent liquids of absorbing very little light at their surface. On comparing the numerous observations made by navigators, we are surprised to see that in the torrid zone, in either hemisphere, they have not found the thermometer to rise in the open sea above 93° ; while in corresponding latitudes on the continents of Asia and Africa, it attains a much greater elevation. The difference between the temperature of the day and night is also less than on land. Gradual changes.

Temperature of the Sea.—From Corunna to the mouth of the Tagus, the temperature of the sea varied little (between 59° and 60.8°); but from lat. 39° to 10° N., the increase was rapid, and generally uniform (from 59° to 78.4°), although inequalities occurred, probably caused by currents. It is very remarkable, that there is a great uniformity in the maximum of heat every where in the equinoctial waters. This maximum, which varies from 82° to 84.2° , proves that the ocean is in general warmer than the atmosphere in direct contact with it, and of which the mean temperature near the equator is from 78.8° to 80.6° . Tempera-
ture of sea.

Hygrometrical State of the Air.—During the whole of the voyage, the apparent humidity of the atmosphere indicated by the hygrometer underwent a sensible increase. In July, in lat. 13° and 14° N., Saussure's hygrometer marked at sea from 88° to 92° , in perfectly clear weather, the thermometer being at 75.2° . On the Hygro-
metrical
state of air.

CHAP. IV

Real
humidity

banks of the Lake of Geneva the mean humidity of the same month is only 80°, the average heat being 66·2°. On reducing these observations to a uniform temperature, we find that the real humidity in the equinoctial basin of the Atlantic Ocean is to that of the summer months at Geneva as 12 to 7. This astonishing degree of moisture in the air accounts to a great extent for the vigorous vegetation which presents itself on the coast of South America, where almost no rain falls during many years.

Intensity
of colour
of sky.

Intensity of the Colour of the Sky and Ocean.—From the coasts of Spain and Africa to those of South America, the azure colour of the sky increased from 13° to 23° of Saussure's cyanometer. From the 8th to the 12th of July, in lat. 12½° and 14° N., the sky, although no vapour could be observed, was of an extraordinary paleness, the instrument indicating only 16° or 17°, although on the preceding days it had been at 22°. The tint of the sky is generally deeper in the torrid zone than in high latitudes, and in the same parallel it is fainter at sea than on land. The latter circumstance may be attributed to the quantity of aqueous vapour which is continually rising towards the higher regions of the air from the surface of the sea. From the zenith to the horizon, there is in all latitudes a diminution of intensity, which follows nearly an arithmetical progression, and depends upon the moisture suspended in the atmosphere. If the cyanometer indicate this accumulation of vapour in the more elevated portion of the air, the seaman possesses a simpler method of judging of the state of its lower regions, by observing the colour and figure of the solar disk at its rising and setting. In the torrid zone, where meteorological phenomena follow each other with great regularity, the prognostics are more to be depended upon than in northern regions. Great paleness of the setting sun, and an extraordinary disfiguration of its disk, almost certainly presage a storm; and yet one can hardly conceive how the condition of the lower strata of the air, which is announced in this manner, can be so intimately

Solar disk.

connected with those atmospherical changes that take place after eight or ten hours. CHAP. IV

Mariners, are accustomed to observe the appearances of the sky more carefully than landsmen, and among the numerous meteorological rules which pilots transmit to each other, several evince great sagacity. Mariners' prognostications. Prognostics are also in general less uncertain on the ocean, and especially in the equinoctial parts of it, than on land, where the inequalities of the ground interrupt the regularity of their manifestation.

Humboldt also applied the cyanometer to measure the colour of the sea. In fine calm weather, the tint was found to be equal to 33°, 38°, sometimes even 44° of the instrument, although the sky was very pale, and scarcely attained 14° or 15°. When, instead of directing the apparatus to a great extent of open sea, the observer fixes his eyes on a small part of its surface viewed through a narrow aperture, the water appears of a rich ultramarine colour. Towards evening again, when the edge of the waves, as the sun shines upon them, is of an emerald-green, the surface of the shaded side reflects a purple hue. Nothing is more striking than the rapid changes which the colour of the sea undergoes under a clear sky, in the midst of the ocean and in deep water, when it may be seen passing from indigo-blue to the deepest green, and from this to slate-gray. Rapid changes. The blue is almost independent of the reflection of the atmosphere. The intertropical seas are in general of a deeper and purer tint than in high latitudes, and the ocean often remains blue, when, in fine weather, more than four-fifths of the sky are covered with light and scattered clouds of a white colour.

CHAPTER V.

Cumana.

Landing at Cumana—Introduction to the Governor—State of the Sick—Description of the Country and City of Cumana—Mode of Bathing in the Manzanares—Port of Cumana—Earthquakes; Their Periodicity; Connexion with the State of the Atmosphere; Gaseous Emanations; Subterranean Noises; Propagation of Shocks; Connexion between those of Cumana and the West Indies; and General Phenomena.

CHAP. V
City of
Cumana.

THE city of Cumana, the capital of New Andalusia, is a mile distant from the landing-place, and in proceeding towards it our travellers crossed a large sandy plain, which separates the suburb inhabited by the Guayqueria Indians from the seashore. The excessive heat of the atmosphere was increased by the reflection of the sun's rays from a naked soil, the thermometer immersed in which rose to 99·9°. In the little pools of salt water it remained at 86·9°, while the surface of the sea in the port generally ranges from 77·4° to 79·3°. The first plant gathered by them was the *Avicennia tomentosa*, which is remarkable for occurring also on the Malabar coast, and belongs to the small number that live in society, like the heaths of Europe, and are seen in the torrid zone only on the shores of the ocean and the elevated platforms of the Andes.

Don Vicente
Emparan.

Crossing the Indian suburb, the streets of which were very neat, they were conducted by the captain of the Pizarro to the governor of the province, Don Vicente Emparan, who received them with frankness; expressed

his satisfaction at the resolution which they had taken of remaining for some time in New Andalusia ; showed them cottons dyed with native plants, and furniture made of indigenous wood ; and surprised them with questions indicative of scientific attainments. On disembarking their instruments, they had the pleasure of finding that none of them had been damaged. They hired a spacious house in a situation favourable for astronomical observations, in which they enjoyed an agreeable coolness when the breeze arose, the windows being without glass, or even the paper panes which are often substituted for it at Cumana. CHAP. V.
Reception.

The passengers all left the vessel. Those who had been attacked by the fever recovered so very slowly, that some were seen a month after, who, notwithstanding the care bestowed upon them by their countrymen, were still in a state of extreme debility. The hospitality of the inhabitants of the Spanish colonies is such that the poorest stranger is sure of receiving the kindest treatment. Among the sick landed here was a negro, who soon fell into a state of insanity and died ; which fact our author mentions, as a proof that persons born in the torrid zone are liable to suffer from the heat of the tropics after having resided in temperate climates. This individual, who was a robust young man, was a native of Guinea, but had lived for some years on the elevated plain of Castile. Recovery of
the sick.
Death of a
negro.

The soil around Cumana is composed of gypsum and calcareous breccia, and is supposed at a remote period to have been covered by the sea. The neighbourhood of the city is remarkable for the woods of cactus which are spread over the arid lands. Some of these plants were thirty or forty feet high, covered with lichens, and divided into branches in the form of a candelabrum. When the large species grow in groups they form a thicket which, while it is almost impenetrable, is extremely dangerous on account of the poisonous serpents that frequent it. Soil and
plants.

The fortress of St Antonio, which is built on a calcar-

CHAP. V
Fortress of
St. Antonio

eous hill, commands the town, and forms a picturesque object to vessels entering the port. On the south-western slope of the same rock are the ruins of the castle of St Mary, from the site of which there is a fine view of the Gulf, together with the island of Margarita and the small isles of Caraccas, Picuita, and Boracha, which present the most singular appearances from the effect of mirage.

Site of the
city.

The city of Cumana, properly speaking, occupies the ground that lies between the castle of St Antonio and the small rivers Manzanares and Santa Catalina. It has no remarkable buildings, on account of the violent earthquakes to which it is subject. The suburbs are almost as populous as the town itself, and are three in number: namely, Serritos, St Francis, and that of the Guayquerias. The latter is inhabited by a tribe of civilized Indians, who, for upwards of a century, have adopted the Castilian language. The whole population in 1802 was about eighteen or nineteen thousand.

Surrounding
country.

The plains which surround the city have a parched and dusty aspect. The hill on which the fort of St Antonio stands is also bare, and composed of calcareous breccia, containing marine shells. Southward, in the distance, is a vast curtain of inaccessible mountains, also of limestone. These ridges are covered by majestic forests, extending along the sloping ground at their base to an open plain in the neighbourhood of Cumana, through which the river Manzanares winds its way to the sea, fringed with mimosas, erythrinas, ceibas, and other trees of gigantic growth.

River Man-
zanares.

This river, the temperature of which in the season of the floods descends as low as 71·6°, when that of the air is as high as 91°, is an inestimable benefit to the inhabitants; all of whom, even the women of the most opulent families, learn to swim. The mode of bathing is various. Our travellers frequented every evening a very respectable society in the suburb of the Guayquerias. In the beautiful moonlight, chairs were placed in the water, on which were seated the ladies and

gentlemen, lightly clothed. The family and the stran- CHAP. V.
 gers passed several hours in the river, smoking cigars Native
 and chatting on the usual subjects of conversation, such pastimes
 as the extreme drought, the abundance of rain in the
 neighbouring districts, and the female luxury which
 prevails in Caracas and Havannah. The company
 were not disturbed by the *bavas*, or small crocodiles,
 which are only three or four feet long, and are now
 extremely rare. Humboldt and his companions did not
 meet with any of them in the Manzanares; but they
 saw plenty of dolphins, which sometimes ascended the
 river at night, and frightened the bathers by spouting
 water from their nostrils.

The port of Cumana is capable of receiving all the Port of
 navies of Europe; and the whole of the Gulf of Cariaco, Cumana.
 which is forty-two miles long and from seven to nine
 miles broad, affords excellent anchorage. The hurricanes
 of the West Indies are never experienced on these coasts,
 where the sea is constantly smooth, or only slightly
 agitated by an easterly wind. The sky is often bright
 along the shores, while stormy clouds are seen to gather
 among the mountains. Thus, as at the foot of the
 Andes, on the western side of the continent, the extremes
 of clear weather and fogs, of drought and heavy rain, of
 absolute nakedness and perpetual verdure, present them-
 selves on the coasts of New Andalusia.

The same analogy exists as to earthquakes, which are Frequency of
 frequent and violent at Cumana. It is a generally- earthquakes.
 received opinion that the Gulf of Cariaco owed its
 existence to a rent of the continent, the remembrance
 of which was fresh in the minds of the natives at the
 time of Columbus' third voyage. In 1530, the coasts
 of Paria and Cumana were agitated by shocks; and
 towards the end of the sixteenth century, earthquakes
 and inundations very often occurred. On the 21st
 October 1766, the city of Cumana was entirely destroyed
 in the space of a few minutes. The earth opened in
 several parts of the province, and emitted sulphureous
 waters. During the years 1766 and 1767, the inhabi-

CHAP. V. — tants encamped in the streets, and they did not begin to rebuild their houses until the earthquakes took place only once in four weeks. These commotions had been preceded by a drought of fifteen months, and were accompanied and followed by torrents of rain which swelled the rivers.

Destruction
of the city.

On the 14th December 1797, more than four-fifths of the city were again entirely destroyed. Previous to this, the shocks had been horizontal oscillations; but the shaking now felt was that of an elevation of the ground, and was attended by a subterraneous noise, like the explosion of a mine at a great depth. The most violent concussion, however, was preceded by a slight undulating motion, so that the inhabitants had time to escape into the streets; and only a few perished, who had betaken themselves for safety to the churches.

Previous
indications

Half an hour before the catastrophe, a strong smell of sulphur was experienced near the hill of the convent of St Francis; and on the same spot an internal noise, which seemed to pass from S.E. to N.W., was heard loudest. Flames appeared on the banks of the Manzanares and in the Gulf of Cariaco. In describing this frightful convulsion of nature, our author enters upon general views respecting earthquakes, of which a very brief account may be here given.

Irregular
occurrences.

The great earthquakes which interrupt the long series of small shocks do not appear to have any stated times at Cumana, as they have occurred at intervals of eighty, of a hundred, and sometimes even of less than thirty years; whereas, on the coasts of Peru,—at Lima, for example,—there is, without doubt, a certain degree of regularity in the periodical devastations thereby occasioned.

Atmospheric
indications.

It has long been believed at Cumana, Acapulco, and Lima, that there exists a perceptible relation between earthquakes and the state of the atmosphere which precedes these phenomena. On the coasts of New Andalusia the people become uneasy when, in excessively hot weather and after long drought, the breeze suddenly

ceases, and the sky, clear at the zenith, presents the appearance of a reddish vapour near the horizon. But these prognostics are very uncertain, and the dreaded evil has arrived in all kinds of weather. CHAP. V.
—

Under the tropics the regularity of the horary variations of the barometer is not disturbed on the days when violent shocks occur. In like manner, in the temperate zone the aurora borealis does not always modify the variations of the needle, or the intensity of the magnetic forces. Effect
on the barometer.

When the earth is opened and agitated, gaseous emanations occasionally escape in places considerably remote from unextinguished volcanoes. At Cumana, flames and sulphureous vapours spring from the arid soil, while in other parts of the same province it throws out water and petroleum. At Riobamba, a muddy inflammable mass called *moya* issues from crevices which close again, and forms elevated heaps. Gaseous emanations. Flames and smoke were also seen to proceed from the rocks of Alvidras, near Lisbon, during the earthquake of 1755, by which that city was ravaged. But in the greater number of earthquakes it is probable that no elastic fluids escape from the ground, and when gases are evolved, they more frequently accompany or follow than precede the shocks. Moya.

The subterranean noise which so frequently attends earthquakes is generally not proportionate to the strength of the shocks. At Cumana it always precedes them; while at Quito, and for some time past at Caraccas and in the West India Islands, a noise like the discharge of a battery was heard long after the agitation had ceased. The rolling of thunder in the bowels of the earth, which continues for months without being accompanied by the least shaking, is a very remarkable phenomenon. Subterranean noise.

In all countries subject to earthquakes the point at which the effects are greatest is considered as the source or focus of the shocks. We forget that the rapidity with which the undulations are propagated to great distances, even across the basin of the ocean, proves the

CHAP. V.
Diffusion
of earth-
quakes.

centre of action to be very remote from the earth's surface. Hence it is clear that earthquakes are not restricted to certain species of rocks, as some naturalists assert, but pervade all; although sometimes, in the same rock, the upper strata seem to form an insuperable obstacle to the propagation of the motion. It is curious also, that in a district of small extent certain formations interrupt the shocks. Thus, at Cumana, before the catastrophe of 1797, the earthquakes were felt only along the southern or calcareous coast of the Gulf of Cariaco, as far as the town of that name, while in the peninsula of Araya, and at the village of Maniquarez, the ground was not agitated. At present, however, the peninsula is as liable to earthquakes as the district around Cumana.

Earthquakes
in New
Andalusia.

In New Andalusia, as in Chili and Peru, the shocks follow the line of the shore, and extend but little into the interior,—a circumstance which indicates an intimate connexion between the causes that produce earthquakes and volcanic eruptions. If the land along the coasts is most agitated because it is generally lowest, why should not the shocks be equally strong in the savannahs, which are only a few yards above the level of the sea?

Relation
of earth-
quakes.

The earthquakes of Cumana are connected with those of the West Indies, and are even suspected to have some relation to the volcanic phenomena of the Andes. On the 4th February 1797, the province of Quito underwent so violent a commotion that 40,000 persons were destroyed; and at the same period shocks were experienced in the Eastern Antilles, followed by an eruption of the volcano of Guadaloupe, in the end of September 1797. On the 14th December the great concussion took place at Cumana.

Extent of
effects.

It has long been remarked, that earthquakes extend their effects to much greater distances than volcanoes; and it is probable, as has just been mentioned, that the causes which produce the former have an intimate connexion with the latter. When seated within the verge

of a burning crater, one feels the motion of the ground several seconds before each partial eruption. The phenomena of earthquakes seem strongly to indicate the action of elastic fluids endeavouring to force their way into the atmosphere. On the shores of the South Sea the concussion is almost instantaneously communicated from Chili to the Gulf of Guayaquil, over a space of 2070 miles. The shocks also appear to be so much the stronger the more distant the country is from active volcanoes; and a province is more agitated, the smaller the number of funnels by which the subterranean cavities communicate with the open air.

CHAP. V.
—
Motion of
the ground.

CHAPTER VI.

Residence at Cumana.

Lunar Halo—African Slaves—Excursion to the Peninsula of Araya
 —Geological Constitution of the Country—Salt-works of Araya
 —Indians and Mulattoes—Pearl-fishery—Maniquarez—Mexican
 Deer—Spring of Naphtha.

CHAP. VI.
 Disturbance
 of visitors.

THE occupations of our travellers were much disturbed during the first weeks of their abode at Cumana, by the intrusion of persons desirous of examining their astronomical and other instruments. They however determined the latitude of the great square to be $10^{\circ} 27' 52''$, and its longitude $64^{\circ} 10' 2''$.

Lunar halo.

On the 17th of August, a halo of the moon attracted the attention of the inhabitants, who viewed it as the presage of a violent earthquake. Coloured circles of this kind, Humboldt remarks, are much rarer in the northern than in the southern countries of Europe. They are seen more especially when the sky is clear and the weather settled. In the torrid zone they appear almost every night, and often in the space of a few minutes disappear several times. Between the latitude of 15° N. and the equator he has seen small haloes around the planet Venus, but never observed any in connexion with the fixed stars. While the halo was seen at Cumana, the hygrometer indicated great humidity, although the atmosphere was perfectly transparent. It consisted of two circles; a larger, of a whitish colour, and 44° in diameter, and a smaller, displaying all the

Planetary
 haloes.

tints of the rainbow, and $1^{\circ} 43'$ in diameter. The intermediate space was of the deepest azure. CHAP. VI

Part of the great square is surrounded with arcades, over which is a long wooden gallery, where slaves imported from the coast of Africa are sold. These were young men from fifteen to twenty years of age. Every morning cocoa-nut oil was given them, with which they rubbed their skin, to render it glossy. The persons who came to purchase them examined their teeth, as we do those of horses, to judge of their age and health. Yet the Spanish laws, according to our author, have never favoured the trade in African slaves, the number of whom in 1800 did not exceed 6000 in the two provinces of Cumana and Barcelona, while the whole population was estimated at 110,000. Slave market.

The first excursion which our travellers made was to the peninsula of Araya. They embarked on the Manzanares, near the Indian suburb, about two in the morning of the 19th August. The night was delightfully cool. Swarms of shining insects (*Elater noctilucus*) sparkled in the air and along the banks of the river. As the boat descended the stream they observed a company of negroes dancing to the music of the guitar by the light of bonfires,—a practice which they prefer to mere relaxation or sleep, on their days of rest. Excursion to Araya.

The bark in which they passed the Gulf of Cariaco was commodious, and large skins of the jaguar were spread for their repose during the night. The cold, however, prevented them from sleeping, although, as they were surprised to find, the thermometer was as high as 71.2° . The circumstance, that in a warm country a degree of cold, which would be productive of no inconvenience to the inhabitant of a temperate climate, excites a disagreeable feeling, is worthy of the attention of physiologists. When Bouguer reached the summit of Pelée, in the island of Martinico, he trembled with cold, although the heat was above 70.7° ; and in heavy showers at Cumana, when the thermometer indi- Great cold.

CHAP. VI. cates the same temperature, the inhabitants make bitter complaints.

Landing.

About eight in the morning they landed at the point of Araya, near the new salt-works, which are situated in a plain destitute of vegetation. From this spot are seen the islet of Cubagua, the lofty hills of Margarita, the ruins of the castle of St Jago, the Cerro de la Vela, and the limestone ridge of the Bergantin, bounding the horizon toward the south. Here salt is procured by digging brine-pits in the clayey soil, which is impregnated with muriate of soda. In 1799 and 1800, the consumption of this article in the provinces of Cumana and Barcelona amounted to 9000 or 10,000 *fanegas*, each 16 *arrobas*, or 405 $\frac{3}{4}$ lbs. avoirdupois. Of this quantity the salt-works of Araya yield only about a third part; the rest being obtained from sea-water in the Morro of Barcelona, at Pozuelos, at Piritu, and in the Golfo Triste.

Salt works.

Geological relations of saliferous clay.

In order to understand the geological relations of this saliferous clay, it is necessary to follow our author in his exposition of the nature of the neighbouring country. Three great parallel chains of mountains extend from east to west. The two most northerly, which are primitive, constitute the cordilleras of the island of Margarita, as well as of Araya. The most southerly, the cordillera of Bergantin and Cocollar, is secondary, although more elevated than the others. The two former have been separated by the sea, and the islets of Coche and Cubagua are supposed to be remnants of the submersed land. The Gulf of Cariaco divides the chains of Araya and Cocollar, which are connected, to the east of the town of Cariaco, between the lakes of Campoma and Putaquo, by a kind of dike. This barrier, which has the name of Cerro de Meapire, prevented, in remote times, the waters of the Gulf of Cariaco from uniting with those of the Gulf of Paria.

Recent deposits.

The western slope of the peninsula of Araya, and the plains on which rises the castle of St Anthony, are covered with recent deposites of sandstone, clay, and

gypsum. Near Maniquarez, a conglomerate with calcareous cement rests on the mica-slate; while on the opposite side, near Punta Delgada, it is superimposed on a compact bluish-gray limestone, containing a few organic remains, traversed by small veins of calcareous spar, and analogous to that of the Alps.

CHAP. VI.
Upper strata.

The saliferous clay is generally of a smoke-gray colour, earthy and friable, but encloses masses of a dark-brown tint and more solid texture. Selenite and fibrous gypsum are disseminated in it. Scarcely any shells are to be seen, although the adjacent rocks contain abundance of them. The muriate of soda is not discoverable by the naked eye; but when a mass is sprinkled with rain-water, and exposed to the sun, it appears in large crystals. In the marsh to the east of the castle of St Jago, which receives only rain-water, crystallized and very pure muriate of soda forms, after great droughts, in masses of large size. The new salt-works of Araya have five very extensive reservoirs, with a depth of eight inches, and are supplied partly with sea-water and partly with rain. The evaporation is so rapid, that salt is collected in eighteen or twenty days after they are filled; and it is freer from earthy muriates and sulphates than that of Europe, although manufactured with less care.

Appearance of saliferous clay.

Muriate of soda.

After examining these works, they departed at the decline of day, and proceeded toward an Indian cabin some miles distant. Night overtook them in a narrow path between a range of perpendicular rocks and the sea. Arriving at the foot of the old castle of Araya, which stands on a bare and arid mountain, and is crowned with agave, columnar cactus, and prickly mimosas, they were desirous of stopping to admire the majestic spectacle, and observe the setting of the planet Venus; but their guide, who was parched with thirst, earnestly urged them to return, and hoped to work on their fears by continually warning them of jaguars and rattlesnakes. They at length yielded to his solicitations; but, after proceeding three quarters of an hour along a shore covered by the tide, they were joined by the negro that carried their

Overtaken by night.

CHAP. VI. provisions, who led them through a wood of nopals to the hut of an Indian, where they were received with cordial hospitality. The several classes of natives in this district live by catching fish, part of which they carry to Cumana. The wealth of the inhabitants consists chiefly of goats, which are of a very large size, and brownish-yellow colour. They are marked like the mules, and roam at large.

Spanish
pride.

Among the mulattoes, whose hovels surrounded the salt-lake near which they had passed the night, they found an indigent Spanish cobbler, who received them with an air of gravity and importance. After amusing them with a display of his knowledge, he drew from a leathern bag a few very small pearls, which he forced them to accept, enjoining them to note on their tablets, "that a poor shoemaker of Araya, but a white man, and of noble Castilian descent, was enabled to give them what, on the other side of the sea, would be sought for as a thing of great value."

Pearl-shell.

The pearl-shell (*Avicula Margaritifera*) is abundant on the shoals which extend from Cape Paria to the Cape of Vela. Margarita, Cubagua, Coche, Punta Araya, and the mouth of the Río la Hacha, were as celebrated in the sixteenth century for them as the Persian Gulf was among the ancients. At the beginning of the conquest, the island of Coche alone furnished 1500 marks (925 Troy pounds) monthly. The portion which the king's officers drew from the produce of the pearls amounted to £3265; and it would appear, that up to 1530 the value of those sent to Europe amounted, at a yearly average, to more than £170,000. Towards the end of the sixteenth century, this fishery diminished rapidly; and, according to Læet, had been long given up in 1633. The artificial imitations, and the great diminution of the shells, rendered it less lucrative. At present, the Gulf of Panama and the mouth of the Río de la Hacha are the only parts of South America in which this branch of industry is continued.

Produce of
the pearls.

On the morning of the 20th, a young Indian conducted

the travellers over Barigon and Caney, to the village of Maniquarez. The thermometer kept as high as 88·3°, and before their guide had travelled a league, he frequently sat down to rest himself, and expressed a desire to repose under the shade of a tamarind-tree until night should approach. Humboldt explains the circumstance, that the natives complain more of lassitude under an intense heat than Europeans not inured to it, by a reference to their listless disposition, and their not being excited by the same stimulus.

CHAP. VI.
Maniquarez.

In crossing the arid hills of Cape Cirial they perceived a strong smell of petroleum, the wind blowing from the side where the springs of that substance occur. Near the village of Maniquarez they found the mica-slate cropping out from below the secondary rocks. It was of a silvery white, contained garnets, and was traversed by small layers of quartz. From a detached block of this last, found on the shore, they separated a fragment of cyanite, the only specimen of that mineral seen by them in South America.

Petroleum.

A rude manufacture of pottery is carried on at that hamlet by the Indian women. The clay is produced by the decomposition of mica-slate, and is of a reddish colour. The natives being unacquainted with the use of ovens, place twigs around the vessels, and bake them in the open air.

Native
pottery.

At the same place they met with some Creoles who had been hunting small deer in the uninhabited islet of Cubagua, where they are very abundant. These creatures are of a brownish-red hue, spotted with white, and of the latter colour beneath. They belong to the species named by naturalists *Cervus Mexicanus*.

Cervus
Mexicanus.

In the estimation of the natives the most curious production of the coast of Araya is what they call the *eye-stone*. They consider it as both a stone and an animal, and assert, that when it is found in the sand it is motionless; whereas on a polished surface, as an earthen plate, it moves when stimulated by lemon-juice. When introduced into the eye, it expels every other substance

Eye-stone.

CHAP. VI
— that may have accidentally insinuated itself. The people offered these stones to the travellers by hundreds, and wished to put sand into their eyes, that they might try the power of this wondrous remedy ; which, however, was nothing else than the operculum of a small shellfish.

Stream of
naphtha. Near Cape de la Brea, at the distance of eighty feet from the shore, is a small stream of naphtha, the produce of which covers the sea to a great extent. It is a singular circumstance that this spring issues from mica-slate, all others that are known belonging to secondary deposites.

After examining the neighbourhood of Maniquarez, the adventurers embarked at night in a small fishing-boat, so leaky that a person was constantly employed in baling out the water with a calabash, and arrived in safety at Cumana.

CHAPTER VII.

Missions of the Chaymas.

Excursion to the Missions of the Chayma Indians—Remarks on Cultivation—The Impossible—Aspect of the Vegetation—San Fernando—Account of a Man who suckled a Child—Cumanacoa—Cultivation of Tobacco—Igneous Exhalations—Jaguars—Mountain of Cocollar—Turimiquirei—Missions of San Antonio and Guanaguana.

On the 4th of September, at an early hour, our travellers commenced an excursion to the missionary stations of the Chayma Indians, and to the lofty mountains which traverse New Andalusia. The morning was deliciously cool; and from the summit of the hill of San Francisco they enjoyed in the short twilight an extensive view of the sea, the adjacent plain, and the distant peaks. After walking two hours they arrived at the foot of the chain, where they found different rocks, together with a new and more luxuriant vegetation. They observed that the latter was more brilliant wherever the limestone was covered by a quartz sandstone,—a circumstance which probably depends not so much on the nature of the soil as on its greater humidity; the thin layers of slate-clay which the latter contains preventing the water from filtering into the crevices of the former. In those moist places they always discovered appearances of cultivation, huts inhabited by mestizoes, and placed in the centre of small enclosures, containing papaws, plantains, sugar-canes, and maize. In Europe, the wheat, barley, and other kinds of grain, cover vast spaces of ground, and, in general, wherever the inhabitants live upon corn, the

CHAP. VII.
Excursion to
the Chayma
missions.

Luxuriant
vegetation.

CHAP VII.
Fertility of
the soil.

cultivated lands are not separated from each other by the intervention of large wastes ; but in the torrid zone, where the fertility of the soil is proportionate to the heat and humidity of the air, and where man has appropriated plants that yield earlier and more abundant crops, an immense population finds ample subsistence on a narrow space. The scattered disposition of the huts in the midst of the forest indicates to the traveller the fecundity of nature.

Moderate
wants.

In so mild and uniform a climate, the only urgent want of man is that of food ; and in the midst of abundance, his intellectual faculties receive less improvement than in colder regions, where his necessities are numerous and diversified. While in Europe, we judge of the inhabitants of a country by the extent of laboured ground ; in the warmest parts of South America, populous provinces seem to the traveller almost deserted, because a very small extent of soil is sufficient for the maintenance of a family. The insulated state in which the natives thus live prevents any rapid progress of civilisation, although it develops the sentiments of independence and liberty.

Barometric
indications.

As the travellers penetrated into the forest the barometer indicated the progressive elevation of the land. About three in the afternoon they halted on a small flat, where a few houses had been erected near a spring, the water of which they found delicious. Its temperature was 72·5°, while that of the air was 83·7°. From the top of a sandstone-hill in the vicinity, they had a splendid view of the sea and part of the coast, while in the intervening space, the tops of the trees, intermixed with flowery lianas, formed a vast carpet of deep verdure. As they advanced toward the south-west the soil became dry and loose. They ascended a group of rather high mountains, destitute of vegetation, and having steep declivities. This ridge is named the *Impossible*, it being imagined that, in case of invasion, it might afford a safe retreat to the inhabitants of Cumana. The prospect was finer and more extensive than from the fountain above mentioned.

They arrived on the summit only a little before dusk. CHAP. VII.
 The setting of the sun was accompanied by a very rapid Summit of the mountain range.
 diminution of temperature, the thermometer suddenly falling from 77·4° to 70·3°, although the air was calm.
 They passed the night in a house at which there was a military post of eight men, commanded by a Spanish sergeant. When, after the capture of Trinidad by the English in 1797, Cumana was threatened, many of the people fled to Cumanacoa, leaving the more valuable of their property in sheds constructed on this ridge. The solitude of the place reminded Humboldt of the nights which he had passed on the top of St Gothard. Several parts of the surrounding forests were burning, and the reddish flames arising amidst clouds of smoke, presented Burning forests.
 a most impressive spectacle. The shepherds set fire to the woods for the purpose of improving the pasturage, though conflagrations are often caused by the negligence of the wandering Indians. The number of old trees on the road from Cumana to Cumanacoa has been greatly reduced by these accidents; and in several parts of the province the dryness has increased, owing both to the diminution of the forests, and the frequency of earthquakes, which produce crevices in the soil.

Leaving the Impossible on the 5th before sunrise, Descent from the mountains.
 they descended by a very narrow path bordering on precipices. The summit of the ridge was of quartz sandstone, beneath which the Alpine limestone reappeared. The strata being generally inclined to the south, numerous springs gush out on that side, and in the rainy season form torrents, which fall in cascades, shaded by the hura, the cuspa, and the trumpet-tree. The cuspa, which is common in the neighbourhood of Cumana, had long been used for carpenter-work, but has of late attracted notice as a powerful tonic or febrifuge.

Emerging from the ravine which opens at the foot of Forest.
 the mountain, they entered a dense forest, traversed by numerous small rivers, which were easily forded. They observed that the leaves of the cecropia were more or

CHAP. VII. less silvery according as the soil was dry or marshy, and
 Cecropia. specimens occurred in which they were entirely green
 on both sides. The roots of these shrubs were concealed
 beneath tufts of *dcrstenia*, a plant which thrives only in
 shady and moist places. In the midst of the forest they
 found papaws and orange-trees bearing excellent fruit,
 which they conjectured to be the remains of some
 Indian plantations; as in these countries they are no
 more indigenous than the banana, the maize, the
 manioc, and the many other useful plants whose native
 country is unknown, although they have accompanied
 man in his migrations from the most remote periods.

Singular
 aspect of
 nature.

“When a traveller newly arrived from Europe,”
 says Humboldt, “penetrates for the first time into the
 forests of South America, Nature presents herself to his
 view in an unexpected aspect; the objects by which he is
 surrounded bear but a faint resemblance to the pictures
 drawn by celebrated writers on the banks of the Missis-
 sippi, in Florida, and in other temperate regions of the
 New World. He perceives at every step, that he is not
 upon the verge, but in the centre of the torrid zone,—
 not in one of the West India islands, but upon a vast
 continent, where the mountains, the rivers, the mass of
 vegetation, and every thing else, are gigantic. If he be
 sensible to the beauties of rural scenery, he finds it
 difficult to account to himself for the diversified feelings
 which he experiences: he is unable to determine what
 most excites his admiration; whether the solemn silence
 of the wilderness, or the individual beauty and contrast
 of the forms, or the vigour and freshness of vegetable
 life that characterize the climate of the tropics. It
 might be said that the earth, overloaded with plants,
 does not leave them room enough for growth. The
 trunks of the trees are every where covered with a
 thick carpet of verdure; and were the orchideæ and the
 plants of the genera *Piper* and *Pothos*, which grow
 upon a single courbaril or American fig-tree, transferred
 to the ground, they would cover a large space. By
 this singular denseness of vegetation, the forests, like

Source of
 admiration.

the rocks and mountains, enlarge the domain of organic nature. The same lianas, which creep along the ground, rise to the tops of the trees, and pass from the one to the other at a height of more than a hundred feet. In consequence of this intermixture of parasitic plants, the botanist is often led to confound the flowers, fruits, and foliage, which belong to different species.”

CHAP. VII.
Denseness of
vegetation.

The philosophers walked for some hours under the shade of these arches, which scarcely admitted an occasional glimpse of the clear blue sky, and for the first time admired the pendulous nests of the orioles, which mingled their warblings with the cries of the parrots and macaws. The latter fly only in pairs, while the former are seen in flocks of several hundreds. At the distance of about a league from the village of San Fernando they issued from the woods, and entered an open country covered with aquatic plants from eight to ten feet high ; there being no meadows or pastures in the lower parts of the torrid zone as in Europe. The road was bordered with a kind of bamboo rising more than forty feet. These plants, according to Humboldt, are less common in America than is usually supposed, although they form dense woods in New Grenada and Quito, and occur abundantly on the western slope of the Andes.

Nests of the
orioles.

They now entered San Fernando, which is situated in a narrow plain, and bounded by limestone rocks. This was the first missionary station they saw in America. The houses of the Chayma Indians were built of clay, strengthened by lianas, and the streets were straight, and intersected each other at right angles. The great square in the centre of the village contains the church, the house of the missionary, and another destined for the accommodation of travellers, which bears the pompous name of the king's house (Casa del Rey). These royal residences occur in all the Spanish settlements, and are of the greatest benefit in countries where there are no inns.

San Fer
nando.

They had been recommended to the friars, who

CHAP. VII.

Reception by
the mission-
aries.

superintend the missions of the Chaymas, by their syndic at Cumana, and the superior, a corpulent and jolly old capuchin, received them with kindness. This respectable personage, seated the greater part of the day in an arm-chair, complained bitterly of the indolence of his countrymen. He considered the pursuits of the travellers as useless, smiled at the sight of their instruments and dried plants, and maintained that of all the enjoyments of life, without excepting sleep, none could be compared with the pleasure of eating good beef.

Founding of
the mission.

This mission was founded about the end of the seventeenth century, near the junction of the Manzanares and Lucas Perez; but, in consequence of a fire, was removed to its present situation. The number of families now amounted to a hundred, and, as the head of the establishment observed, the custom of marrying at a very early age contributes greatly to the rapid increase of population.

Francisco
Lozano.

In the village of Arenas, which is inhabited by Indians of the same race as those of San Fernando, there lived a labourer, Francisco Lozano, who had suckled a child. Its mother happening to be sick, he took it, and in order to quiet it, pressed it to his breast, when the stimulus imparted by the sucking of the child caused a flow of milk. The travellers saw the certificate drawn up on the spot to attest this remarkable fact, of which several eyewitnesses were still living. The man was not at Arenas during their stay at the mission, but afterwards visited them at Cumana, accompanied by his son, when M. Bonpland examined his breasts, and found them wrinkled, like those of women who have nursed. He was not an Indian, but a white descended from European parents. Alexander Benedictus relates a similar case of an inhabitant of Syria, and other authors have given examples of the same nature.

Singular
occurrence.

Cumanacoa

Returning towards Cumana, they entered the small town of Cumanacoa, situated in a naked and almost circular plain, surrounded by lofty mountains, and containing about two thousand three hundred inhabitants.

The houses were low and slight, and with very few exceptions built of wood. The travellers were surprised to find the column of mercury in the barometer scarcely 7·3 lines shorter than on the coast. The hollow on which the town is erected is not more than 665 feet above the level of the sea, and only twenty-four miles from Cumana; but the climate is much colder than in the latter place, where it scarcely ever rains; whereas at Cumanacoa there are seven months of severe weather. It was during the winter season that our travellers visited the missions. A dense fog covered the sky every night; the thermometer varied from 65° to 68°; and Deluc's hygrometer indicated 85°. At ten in the morning the thermometer did not rise above 69·8°, but from noon to three o'clock attained the height of from 78·8° to 80·6°. About two, large black clouds regularly formed, and poured down torrents of rain accompanied by thunder. At five the rain ceased, and the sun reappeared; but at eight or nine the fog again commenced. In consequence of the humidity, the vegetation, although not very diversified, is remarkable for its freshness. The soil is highly fertile; but the most valuable production of the district is tobacco, the cultivation of which in the province of Cumana is nearly confined to this valley.

Next to the tobacco of Cuba and the Rio Negro, that grown here is the most aromatic. The seed is sown in the beginning of September, and the cotyledons appear on the eighth day. The young plants are then covered with large leaves to protect them from the sun. A month or two after, they are transferred to a rich and well-prepared soil, and disposed in rows, three or four feet distant from each other. The whole is carefully weeded, and the principal stalk is several times topped, until the leaves are mature, when they are gathered. They are then suspended by threads of the *Agave Americana*, and their ribs taken out; after which they are twisted. The cultivation of tobacco was a royal monopoly, and employed about 1500 persons. Indigo is also raised in the valley of Cumanacoa.

CHAP. VII.
Barometrical
observations.

Rain and
thunder.

Tobacco
culture.

CHAP. VII. This singular plain appeared to be the bed of an ancient lake. The surrounding mountains are all precipitous, and the soil contains pebbles and bivalve shells. One of the gaps in the range, they were informed, was inhabited by jaguars, which passed the day in caves, and roamed about the plantations at night. The preceding year, one of them had devoured a horse belonging to a farm in the neighbourhood. The groans of the dying animal awoke the slaves, who went out armed with lances and large knives, with which they despatched the tiger after a vigorous resistance.

Plain of Cumanacoa.

Fire caverns. From two caverns in this ravine there at times issue flames, which illumine the adjacent mountains, and are seen to a great distance at night. The phenomenon was accompanied by a long-continued subterraneous noise at the time of the last earthquake. A first attempt to penetrate into this pass was rendered unsuccessful by the strength of the vegetation and the intertwining of lianas and thorny plants; but the inhabitants becoming interested in the researches of the travellers, and being desirous to know what the German miner thought of the gold ore which they imagined to exist in it, cleared a path through the woods. On entering the ravine they found traces of jaguars; and the Indians returned for some small dogs, upon which they knew these animals would spring in preference to attacking a man. The rocks that bound it are perpendicular, and what geologists term Alpine limestone. The excursion was rendered hazardous by the nature of the ground; but they at length reached the pretended gold mine, which was merely an excavation in a bed of black marl containing iron pyrites,—a substance which the guides insisted was no other than the precious metal.

Search for gold.

Caverns. They continued to penetrate into the crevice, and after undergoing great fatigue, reached a wall of rock, which, rising perpendicularly to the height of 5116 feet, presented two inaccessible caverns inhabited by nocturnal birds. Halting at the foot of one of the caves from which flames had been seen to issue, they listened

to the remarks of the natives respecting the probability of an increase in the frequency of the agitations to which New Andalusia had so often been subjected. The cause of the luminous exhalations, however, they were unable to ascertain. CHAP. VII.

On the 12th they continued their journey to the convent of Caripe, the principal station of the Chayma missions, choosing, instead of the direct road, the line of the mountains Cocollar and Turimiquiri. At the Hato de Cocollar, a solitary farm situated on a small elevated plain, they rested for some days, and had the good fortune to enjoy at once a delightful climate and the hospitality of the proprietor. From this elevated point, as far as the eye could reach, they saw only naked savannahs, although in the neighbouring valleys they found tufts of scattered trees, and a profusion of beautiful flowers. The upper part of the mountain was destitute of wood, though covered with gramineous plants,—a circumstance which Humboldt attributes more to the custom of burning the forests than to the elevation of the ground, which is not sufficient to prevent the growth of trees. Convent of Caripe.

Their host, Don Mathias Yturburi, a native of Biscay, had visited the New World with an expedition the object of which was to form establishments for procuring timber for the Spanish navy. But these natives of a colder climate were unable to support the fatigue of so laborious an occupation, the heat, and the effect of noxious vapours. Destructive fevers carried off most of the party, when this individual withdrew from the coast, and settling on the Cucollar, became the undisturbed possessor of five leagues of savannahs, among which he enjoyed independence and health. Don Mathias Yturburi.

“Nothing,” says Humboldt, “can be compared to the impression of the majestic tranquillity left on the mind by the view of the firmament in this solitary place. Following with the eye, at evening-tide, those meadows which stretch along the horizon, and the gently undulated plain covered with plants, we thought we saw in Impression on the mind.

CHAP. VII. the distance, as in the deserts of the Orinoco, the
 Vast plain. surface of the ocean supporting the starry vault of
 heaven. The tree under which we were seated, the
 luminous insects that vaulted in the air, and the con-
 stellations which shone in the south, seemed to tell us
 that we were far from our native land. In the midst of
 this exotic nature, when the bell of a cow or the lowing
 of a bull was heard from the bottom of a valley, the
 remembrance of our country was suddenly awakened by
 the sounds. They were like distant voices, that came
 from beyond the ocean, and by the magic of which we
 were transported from the one hemisphere to the other.
 Strange mobility of the human imagination, the never-
 failing source of our enjoyments and griefs!"

Ascent of
 Turimiquirei. . In the cool of the morning they commenced the
 ascent of Turimiquirei, the summit of the Cocoliar,
 which with the Brigantine forms a mass of mountains,
 formerly named by the natives the Sierra de los Tageres.
 They travelled part of the way on horses, which are
 left to roam at large in these wilds, though some of them
 have been trained to the saddle. Stopping at a spring
 which issued from a bed of quartz sandstone, they
 found its temperature to be 69·8°. To the height of
 4476 feet, this mountain, like those in its vicinity, was
 covered with gramineous plants. The pastures became
 less rich in proportion to the elevation, and wherever
 the scattered rocks afforded a shade lichens and mosses
 occurred. The summit is 4521 feet above the level of
 the sea. The view from it was extensive and highly
 picturesque: chains of mountains, running from east
 to west, enclosed longitudinal valleys, which were inter-
 secting at right angles by numberless ravines. The
 distant peninsula of Araya formed a dark streak on a
 glittering sea, and the more distant rocks of Cape
 Macanao rose amidst the waters like an immense ram-
 part.

Highest
 point.
 Cocoliar. On the 14th of September they descended the Cocoliar
 in the direction of San Antonio, where was also a
 mission. After passing over savannahs strewn with

blocks of limestone, succeeded by a dense forest and two very steep ridges, they came to a beautiful valley, about twenty miles in length, in which are situated the missions of San Antonio and Guanaguana. Stopping at the former only to open the barometer and take a few altitudes of the sun, they forded the rivers Colorado and Guarapiche, and proceeding along a level and narrow road covered with thick mud, amid torrents of rain, reached in the evening the latter of these stations, where they were cordially received by the missionary. This village had existed only thirty years on the spot which it then occupied, having been transferred from a place more to the south. Humboldt remarks, that the facility with which the Indians remove their dwellings is astonishing, there being several small towns in South America which have thrice changed their situation in less than half a century. These compulsory migrations are not unfrequently caused by the caprice of an ecclesiastic ; and as the houses are constructed of clay, reeds, and palm-leaves, a hamlet shifts its position like a camp.

CHAP. VII.
Mansion of
San Antonio.

Removal of
villages.

The mission of San Antonio had a small church with two towers, built of brick, and ornamented with Doric columns, the wonder of the country ; but that of Guanaguana possessed as yet no place of worship, although a spacious house had been built for the padre, the terraced roof of which was ornamented with numerous chimneys like turrets, and which, he informed the travellers, had been erected for no other purpose than to remind him of his native country. The Indians cultivate cotton. The machines by which they separate the wool from the seeds are of very simple construction, consisting of wooden cylinders of very small diameter, made to revolve by a treadle. Maize is the article on which they principally depend for food ; and when it happens to be destroyed by a protracted drought, they betake themselves to the surrounding forests, where they find subsistence in succulent plants, cabbage-palms, fern-roots, and the produce of various trees.

Church of
San Antonio.

Cultivation
of cotton.

Proceeding towards the valley of Caripe, the travellers

CHAP. VII. Valley of Caripe. passed a limestone ridge which separates it from that of Guanaguana,—an undertaking which they found rather difficult, the path being in several parts only fourteen or fifteen inches broad, and the slopes being covered with very slippery turf. When they had reached the summit, an interesting spectacle presented itself to their view, consisting of the vast savannahs of Maturin and Rio Tigre, the Peak of Turimiquiri, and a multitude of parallel hills resembling the waves of a troubled ocean.

Woody country.

Descending the height by a winding path, they entered a woody country, where the ground was covered by moss and a species of *Drosera*. As they approached the convent of Caripe, the forests grew more dense, and the power of vegetation increased. The calcareous strata became thinner, forming graduated terraces, while the stone itself assumed a white colour, with a smooth or imperfectly conchoidal fracture. This rock Humboldt considers as analogous to the Jura deposits. He found the level of the valley of Caripe 1279 feet higher than that of Guanaguana. Although the former is only separated from the latter by a narrow ridge, it affords a complete contrast to it, being deliciously cool and salubrious, while the other is remarkable for its great heat.

CHAPTER VIII.

Excursion continued, and Return to Cumana.

Convent of Caribe—Cave of Guacharo, inhabited by Nocturnal Birds—Purgatory—Forest Scenery—Howling Monkeys—Vera Cruz—Cariaco—Intermittent Fevers—Cocoa-trees—Passage across the Gulf of Cariaco to Cumana.

ARRIVING at the hospital of the Arragonese Capuchins, CHAP. VIII which was backed by an enormous wall of rocks of resplendent whiteness, covered with a luxuriant vegetation, our travellers were hospitably received by the monks. The superior was absent; but having heard of their intention to visit the place, he had provided for them whatever could serve to render their abode agreeable. The inner court, surrounded by a portico, they found highly convenient for setting up their instruments and making observations. In the convent they found a numerous society, consisting of old and infirm missionaries, who sought for health in the salubrious air of the mountains of Caribe, and younger ones newly arrived from Spain. Although the inmates of this establishment knew that Humboldt was a Protestant, they manifested no mark of distrust, nor proposed any indiscreet question, to diminish the value of the benevolence which they exercised with so much liberality. Even the light of science had in some degree extended to this obscure place; for, in the library of the superior, they found among other books the *Traité d'Electricité*, by the Abbé Nollet, and one of the monks had brought with him a Spanish translation of Chaptal's *Treatise on Chemistry*.

CHAP. VIII.

Elevation of
the site.

The height of this monastery above the sea is nearly the same as that of Caraccas and the inhabited parts of the Blue Mountains of Jamaica. The thermometer was between $60\cdot8^{\circ}$ and $63\cdot5^{\circ}$ at midnight, between $66\cdot2^{\circ}$ and 68° in the morning, and only $69\cdot8^{\circ}$ or $72\cdot5^{\circ}$ about one o'clock. The mean temperature, inferred from that of the month of September, appears to be $65\cdot3^{\circ}$. This degree of heat is sufficient to develop the productions of the torrid zone, although much inferior to that of the plains of Cumana. Water exposed in vessels of porous clay cools during the night as low as $55\cdot4^{\circ}$. The mild climate and rarified air of this place have been found highly favourable to the cultivation of coffee, which was introduced into the province by the prefect of the Capuchins, an active and enlightened man. In the garden of the community were many culinary vegetables, maize, the sugar-cane, and five thousand coffee-trees.

Cultivation
of coffee.

Cave of
Guacharo.

The greatest curiosity in this beautiful and salubrious district is a cavern inhabited by nocturnal birds, the fat of which is employed in the missions for dressing food. It is named the Cave of Guacharo, and is situated in a valley three leagues distant from the convent.

Natural
aviary.

On the 18th of September our travellers, accompanied by most of the monks and some of the Indians, set out for this aviary, following for an hour and a half a narrow path, leading across a fine plain covered with beautiful turf; then, turning westward along a small river which issues from the cave, they proceeded, during three quarters of an hour, sometimes walking in the water, sometimes on a slippery and miry soil between the torrent and a wall of rocks, until they arrived at the foot of the lofty mountain of Guacharo. Here the torrent ran in a deep ravine, and they went on under a projecting cliff which prevented them from seeing the sky, until at the last turning they came suddenly upon the immense opening of the recess, which is eighty-five feet broad and seventy-seven feet high. The entrance is toward the south, and is formed in the vertical face of a rock, covered with trees of gigantic height, intermixed

with numerous species of singular and beautiful plants, some of which hang in festoons over the vault. This luxuriant vegetation is not confined to the exterior of the cave, but appears even in the vestibule, where the travellers were astonished to see heliconias nineteen feet in height, palms, and arborescent arums. They had advanced about four hundred and sixty feet before it became necessary to light their torches, when they heard from afar the hoarse screams of the birds.

The guacharo is the size of a domestic fowl, and has somewhat the appearance of a vulture, with a mouth like that of a goatsucker. It forms a distinct genus in the order *Passeres*, differing from that just named in having a stronger beak, furnished with two denticulations, though in its manners it bears an affinity to it as well as to the Alpine crow. Its plumage is dark bluish-gray, minutely streaked and spotted with black, the head, wings, and tail, being marked with white spots bordered with black. The extent of the wings is three feet and a half. It lives on fruits, but quits the cave only in the evening. The shrill and piercing cries of these birds, assembled in multitudes, are said to form a harsh and disagreeable noise, somewhat resembling that of a rookery. The nests, which the guides showed by means of torches fastened to a long pole, were placed in funnel-shaped holes in the roof. The noise increased as they advanced, the animals being frightened by the numerous lights.

About midsummer every year, the Indians armed with poles enter the cave, and destroy the greater part of the nests. Several thousands of young birds are thus killed, and the old ones hover around, uttering frightful cries. Those which are secured in this manner are opened on the spot, to obtain the fat which exists abundantly in their abdomen, and which is subsequently melted in clay vessels over fires of brushwood. This substance is semifluid, transparent, destitute of smell, and keeps above a year without becoming rancid. At

CHAP. VIII.
Luxurious
vegetation.

The gua-
charo.

Destruction
of their
young.

CHAP. VIII. the convent of Caripe it was used in the kitchen of the monks, and our travellers never found that it communicated any disagreeable smell or taste to the food.

Superstitious
fears.

The guacharoes would have been long ago destroyed, had not the superstitious dread of the Indians prevented them from penetrating far into the cavern. It also appears that birds of the same species dwell in other inaccessible places in the neighbourhood, and that the great cave is repopled by colonies from them. The hard and dry fruits which are found in the crops and gizzards of the young ones are considered as an excellent remedy against intermittent fevers, and regularly sent to Cariaco and other parts of the lower districts where such diseases prevail.

Extent of
the cave.

The travellers followed the banks of the small river which issues from the cavern as far as the mounds of calcareous incrustations permitted them, and afterwards descended into its bed. The cave preserved the same direction, breadth, and height, as at its entrance, to the distance of 1548 feet. The natives having a belief that the souls of their ancestors inhabit its deep recesses, the Indians who accompanied our travellers could hardly be persuaded to venture into it. Shooting at random in the dark, they obtained two specimens of the guacharo. Having proceeded to a certain distance, they came to a mass of stalactite, beyond which the cave became narrower, although it retained its original direction. Here the rivulet had deposited a blackish mould resembling that observed at Mugendorf in Franconia. The seeds, which the birds carry to their young, spring up wherever they are dropped into it; and M. Humboldt and his friend were astonished to find blanched stalks that had attained a height of two feet.

Inner
recesses.

Return of
the party.

As the missionaries were unable to persuade the Indians to advance farther, the party returned. The river, sparkling amid the foliage of the trees, seemed like a distant picture, to which the mouth of the cave formed a frame. Having sat down at the entrance to

enjoy a little needful repose, they partook of a repast which the missionaries had prepared, and in due time returned to the convent. CHAP. VIII

The days which our travellers passed at this religious house glided hastily and pleasantly away. From morning to night they traversed the forests and mountains collecting plants; and when the rains prevented them from making distant excursions, they visited the huts of the Indians; returning to the good monks only when the sound of the bell called them to the solace of the refectory. Sometimes also they followed them to the church, to witness the religious instruction given to the Indians; which was found a difficult task, owing to the imperfect knowledge of the Spanish language possessed by the latter. The evenings were employed in taking notes, drying plants, and sketching those that appeared new. Occupation
of time.

The natural beauties of this interesting valley engaged them so much, that they were long in perceiving the embarrassment felt by their kind entertainers, who had now but a very slender store of wine and bread. At length, on the 22d September, they departed, followed by four mules carrying their instruments and plants. The descent of the rugged chain of the Brigantine and Cocollar, which is about 4400 feet in height, is exceedingly difficult. The missionaries have given the name of Purgatory to an extremely steep and slippery declivity at the base of a sandstone rock, in passing which the mules, drawing their hind legs under their bodies, slide down at a venture. From this point they saw toward the left the great peak of Guacharo, which presented a very picturesque appearance; and soon after entered a dense forest, through which they descended for seven hours in a kind of ravine, the path being formed of steps from two to three feet high, over which the mules leaped like wild goats. The Creoles have sufficient confidence in these animals to remain in their saddles during this dangerous passage; but our travellers preferred walking. Embarrassment
of
their hosts.
Purgatory.

The forest was exceedingly dense, and consisted of

CHAP. VIII. trees of stupendous size. The guides pointed out some whose height exceeded 130 feet, while the diameter of many of the curucays and hymeneas was more than three yards. Next to these, the plants which most attracted their notice were the dragon's-blood (*Croton sanguifluum*), the purple juice of which flowed along the whitish bark, various species of palms, and arborescent ferns of large size. The old trunks of some of the latter were covered with a carbonaceous powder, having a metallic lustre like graphite.

Immense trees.

Palma.

As they descended the mountain the tree-ferns diminished, while the number of palms increased. Large-winged butterflies (*nymphales*) became more common, and every thing showed that they were approaching the coast. The weather was cloudy, the heat oppressive, and the howling of the monkeys gave indication of a coming thunder-storm. These creatures, the arguatoes, resemble a young bear, and are about three feet long from the top of the head to the root of the tail. The fur is bushy and reddish-brown, the face blackish-blue, with a bare and wrinkled skin, and the tail long and prehensile.

Travelling Indians.

While engaged in observing a troop of them cross the road upon the horizontal branches of the trees, the travellers met a company of naked Indians proceeding towards the mountains of Caripe. The men were armed with bows and arrows, and the women, heavily laden, brought up the rear. They marched in silence, with their eyes fixed on the ground. Our philosophers, oppressed with the increasing heat and faint with fatigue, endeavoured to learn from them the distance of the missionary convent of Vera Cruz, where they intended to pass the night; but little information could be obtained on account of their imperfect knowledge of the Spanish language.

Savannah.

Continuing to descend amid scattered blocks, they unexpectedly found themselves at the end of the forest, when they entered a savannah, the verdure of which had been renewed by the winter rains. Here they had

a splendid view of the Sierra del Guacharo, the northern declivity of which presented an almost perpendicular wall, exceeding 3200 feet in height, and scantily covered with vegetation. The ground before them consisted of several level spaces, lying above each other like vast steps. The mission of Vera Cruz, which is situated in the middle of it, they reached in the evening, and next day continued their journey toward the Gulf of Cariaco.

CHAP. VIII.
Sierra del
Guacharo.

Proceeding on their way they entered another forest, and reached the station of Catuaro, situated in a very wild spot, where they lodged at the house of the priest. Their host was a doctor of divinity, a thin little man, of petulant vivacity, who talked continually of a lawsuit in which he was engaged with the superior of his convent, and wished to know what Humboldt thought of free-will and the souls of animals. At this place they met with the corregidor of the district, an amiable person, who gave them three Indians to assist in cutting a way through the forest, the lianas and intertwining branches having obstructed the narrow lanes. The little missionary, however, insisted on accompanying them to Cariaco, and contrived to render the road extremely tedious by his observations on the necessity of the slave-trade, the innate wickedness of blacks, and the benefit which they derived from being reduced to bondage by Christians.

Catuaro.

The road which they followed through the forest of Catuaro resembled that of the preceding day. The clay, which filled the path and rendered it excessively slippery, was produced by layers of sandstone and slate-clay which cross the calcareous strata. At length, after a fatiguing march, they reached the town of Cariaco, on the coast, where they found a great part of the inhabitants confined to their beds with intermittent fever. The low situation of the place as well as of the surrounding district, the great heat and moisture, and the stagnant marshes generated during the rainy season, are supposed to be the causes of this disease, which often assumes a malignant character, and is accompanied with

Road
through
the forest.

Cariaco.

CHAP. VIII. dysentery. Men of colour, and especially Creole negroes, resist the influence of the climate much better than any other race. It is generally observed, however, that the mortality is less than might be supposed; for although intermittent fevers, when they attack the same individual several years in succession, alter and weaken the constitution, they do not usually cause death. It is remarkable that the natives believe the air to have become more vitiated in proportion as a larger extent of land has been cultivated; but the miasmata from the marshes, and the exhalations from the mangroves, *avicenniæ*, and other astringent plants growing on the borders of the sea, are probably the real causes of the unhealthiness of the coasts.

Population
of Cariaco.

In 1800 the town of Cariaco contained more than 6000 inhabitants, who were actively employed in the cultivation of cotton, the produce of which exceeded 10,000 quintals (9057 cwts. avoirdupois). The capsules, after the separation of the wool, were carefully burnt, as they were thought to occasion noxious exhalations when thrown into the river. Cacao and sugar were also raised to a considerable extent.

Embarka-
tion on the
Carenicuár.

As our travellers were not sufficiently inured to the climate, they considered it prudent to leave Cariaco as expeditiously as possible on account of the fever. Embarking early in the morning, they proceeded westward along the river of Carenicuár, which flows through a deep marshy soil covered with gardens and plantations of cotton. The Indian women were washing their linen with the fruit of the *parapara* (*Sapindus saponaria*). Contrary winds, accompanied with heavy rain and thunder, rendered the voyage disagreeable; more especially as the canoe was narrow and overloaded with raw sugar, plantains, cocoa-nuts, and passengers. Swarms of flamingoes, egrets, and cormorants, were flying toward the shore, while the alcatras, a large species of pelican, less affected by the weather, continued fishing in the bay. The general depth of the sea is from 288 to 320 feet; but at the eastern extremity of the gulf it is only

from nineteen to twenty-five feet for an extent of seven-
 teen miles, and there is a sandbank, which at low water
 resembles a small island. They crossed the part where
 the hot springs rush from the bottom of the ocean ; but
 it being high water the change of temperature was not
 very perceptible. The contrary winds continuing, they
 were forced to land at Pericantral, a small farm on the
 south side of the gulf. The coast, although covered by
 a beautiful vegetation, was almost destitute of human
 labour, and scarcely possessed seven hundred inhabitants.
 The cocoa-tree is the principal object of cultivation.
 This palm thrives best in the neighbourhood of the sea,
 and like the sugar-cane, the plantain, the mammee-apple,
 and the alligator-pear, may be watered either with fresh
 or salt water. In other parts of America it is generally
 nourished around farm-houses ; but along the Gulf of
 Cariaco it forms real plantations ; and at Cumana they
 talk of a *hacienda de coco*, as they do of a *hacienda de
 canna*, or *de cacao*. In moist and fertile ground it begins
 to bear abundantly the fourth year ; but in dry soils it
 does not produce fruit until the tenth. Its duration
 does not generally exceed eighty or a hundred years ; at
 which period its mean height is about eighty feet.
 Throughout this coast a cocoa-tree supplies annually
 about a hundred nuts, which yield eight foscas of oil.
 The fasco is sold for about sixteenpence. A great
 quantity is made at Cumana, and Humboldt frequently
 witnessed the arrival there of canoes containing 3000
 nuts. The oil, which is clear and destitute of smell, is
 well adapted for burning.

After sunset they left the farm of Pericantral, and at
 three in the morning reached the mouth of the Manza-
 nares, after passing a very indifferent night in a narrow
 and deeply laden canoe. Having been for several weeks
 accustomed to mountain-scenery, gloomy forests, and
 rainy weather, they were struck by the bareness of the
 soil, the clearness of the sky, and the mass of reflected
 light by which the neighbourhood of Cumana is charac-
 terized. At sunrise they saw the *samuro* vultures

CHAP. VIII.

Depth of
the sea.

Cocoa tree.

Mouth of the
Manzanares.

CHAP. VIII. (*Vultur aura*) perched on the cocoa-trees in large flocks. These birds go to roost long before night, and do not quit their place of repose until after the heat of the solar rays is felt. The same idleness, as it were, is indulged by the trees with pinnate leaves, such as the mimosas and tamarinds, which close these organs half an hour before the sun goes down, and unfold them in the morning only after he has been some time visible. In our climates the leguminous plants open their leaves during the morning twilight. Humboldt seems to think that the humidity deposited upon the parenchyma by the refrigeration of the foliage, which is the effect of the nocturnal radiation, prevents the action of the first rays of the sun upon them.

Flock of
vultures.

CHAPTER IX.

Indians of New Andalusia.

Physical Constitution and Manners of the Chaymas—Their Languages—American Races.

It is the custom of Humboldt, in his "Journey to the Equinoctial Regions," to stand still after an excursion, reflect, and present to his readers the result of his inquiries on any subject that has fixed his attention. For example, on concluding the narrative of his visit to the Chayma missions, he gives a general account of the aborigines of New Andalusia, of which an abridgment is here offered.

The north-eastern part of Equinoctial America, Terra Firma, and the shores of the Orinoco, resemble, in the multiplicity of the tribes by which they are inhabited, the defiles of Caucasus, the mountains of Hindoo-kho, and the northern extremity of Asia, beyond the Tungooses and the Tartars of the mouth of the Lena. The barbarism which prevails in these various regions is perhaps less owing to an original absence of civilisation than to the effects of a long debasement; and if every thing connected with the first population of a continent were known, we should probably find that savages are merely tribes banished from society and driven into the forests. At the commencement of the conquest of America, the natives were collected into large bodies only on the ridge of the Cordilleras and the coast opposite to Asia, where the vast savannahs, and the great plains

CHAP. IX. covered by forests and intersected by rivers, presented wandering tribes, separated by differences of language and manners.

Number of aborigines.

In Cumana and New Barcelona, the aborigines still form fully one-half of the scanty population. Their number may be about 60,000, of which 24,000 inhabit New Andalusia. This amount appears large when we refer to the hunting-tribes of North America, but seems the reverse when we look to those districts of New Spain where agriculture has been followed for more than eight centuries. Thus, the intendency of Oaxaca, which forms part of the old Mexican empire, and which is one-third smaller than the two provinces of Cumana and Barcelona, contains more than 400,000 of the original race. The Indians of Cumana do not all live assembled in the missions, some being found dispersed in the neighbourhood of towns along the coasts. The stations of the Arragonese Capuchins contain 15,000, almost all of the Chayma tribe. The villages, however, are less crowded than in the province of Barcelona, their indigenous population being only between five and six hundred; whereas, more to the west, in the establishments of the Franciscans of Piritoo, there are towns of 2000 or 3000 inhabitants. Besides the 60,000 natives of the provinces of Cumana and Barcelona, there are some thousands of Guaraunos who have preserved their independence in the islands at the mouth of the Orinoco. Excepting a few families, there are no wild Indians in New Andalusia.

Missionary stations

Distinctions among the Indians.

The term *wild* or *savage*, Humboldt says he uses with regret, because it implies a difference of cultivation which does not always exist between the *reduced* or *civilized* Indian, living in the missions, and the free or independent Indian. In the forests of South America there are tribes which dwell in villages, rear plantains, cassava, and cotton, and are scarcely more barbarous than those in the religious establishments, who have been taught to make the sign of the cross. It is an error to consider all the free natives as wandering hunters; for agriculture existed on the continent long before the arrival of the

Europeans, and still exists between the Orinoco and the
 Amazons, in districts to which they have never penetrated. The system of the-missions has produced an
 attachment to landed property, a fixed residence, and a
 taste for quiet life ; but the baptized Indian is often as
 little a Christian as his heathen brother is an idolater,—
 both discovering a marked indifference for religious
 opinions, and a tendency to worship nature.

CHAP. IX.
 Practice of
 agriculture.

There is no reason to believe, that in the Spanish
 colonies the number of Indians has diminished since the
 conquest. There are still more than six millions of the
 copper-coloured race in both Americas ; and although
 tribes and languages have been destroyed or blended in
 those colonies, the natives have in fact continued to in-
 crease. In the temperate zone the contact of Europeans
 with the indigenous population becomes fatal to the
 latter ; but in South America the result is different, and
 there they do not dread the approach of the whites. In
 the former case a vast extent of country is required by
 the Indians, because they live by hunting ; but in the
 latter a small piece of ground suffices to afford subsistence
 for a family.

Increase of
 the natives.

In these provinces the Europeans advance slowly ;
 and the religious orders have founded establishments
 between the regions inhabited by them and those pos-
 sessed by the independent Indians. The missions have
 no doubt encroached on the liberty of the natives, but
 they have generally been favourable to the increase of
 the population. As the preachers advance into the in-
 terior the planters invade their territory ; the whites
 and the castes of mixed breed settle among the Indians ;
 the missions become Spanish villages ; and finally, the
 old inhabitants lose their original manners and language.
 In this way civilisation advances from the coasts towards
 the centre of the continent.

Religious
 establish-
 ments.

New Andalusia and Barcelona contain more than
 fourteen tribes of Indians. Those of the former are the
 Chaymas, Guayquerias, Pariagotos, Quaquas, Aruacas,
 Caribs, and Guaraunos ; and those of the latter, the

Indian tribes.

CHAP. IX. Cumanagotos, Palenkas, Caribs, Piritos, Tomoozas, Topocuares, Chacopatas, and Guarivas. The precise number of the Guaraunos, who live in huts elevated on trees at the mouth of the Orinoco, is not known. There are two thousand Guayquerias in the suburbs of Cumana and the peninsula of Araya. Of the other tribes the Chaymas of the mountains of Caripe, the Caribs of New Barcelona, and the Cumanagotos of the missions of Piritoo, are the most numerous. The language of the Guaraunos, and that of the Caribs, Cumanagotos, and Chaymas, are the most general, and seem to belong to the same stock.

Huts on trees.

Distinction of tribes. Although the Indians attached to the missions are all agriculturists, cultivate the same plants, build their huts in the same manner, and lead the same kind of life, yet the shades by which the several tribes are distinguished remain unchanged. There are few of these villages in which the families belong to different tribes, and speak different languages. The missionaries have indeed prohibited the use of various practices and ceremonies, and have destroyed many superstitions; but they have not been able to alter the essential character common to all the American races from Hudson's Bay to the Straits of Magellan. The instructed Indian, more secure of subsistence than the untamed native, and less exposed to the fury of hostile neighbours or of the elements, leads a more monotonous life, possesses the mildness of character which arises from the love of repose, and assumes a sedate and mysterious air; but the sphere of his ideas has received little enlargement, and the expression of melancholy which his countenance exhibits is merely the result of indolence.

Mildness of character.

The Chaymas.

The Chaymas, of whom more than fifteen thousand inhabit the Spanish villages, and who border on the Cumanagotos toward the west, the Guaraunos toward the east, and the Caribs toward the south, occupy part of the elevated mountains of the Cocollar and Guacharo, as also the banks of the Guarapiche, Rio Colorado, Arco, and the Cano of Caripe. The first attempt to reduce

them to subjection was made in the middle of the seventeenth century by Father Francisco of Pamplona, a person of great zeal and intrepidity. The missions subsequently formed among these people suffered greatly in 1681, 1697, and 1720, from the invasion of the Caribs; while during six years subsequently to 1730 the population was diminished by the ravages of the small-pox. CHAP. IX.

The Chaymas are generally of low stature, their ordinary height being about five feet two inches; but their figures are broad and muscular. The colour of the skin is a dull brown inclining to red. The expression of the countenance is sedate and somewhat gloomy; the forehead is small and retiring; the eyes sunk, very long and black, but not so small or oblique as in the Mongolian race; the eyebrows slender, nearly straight, and black or dark-brown, and the eyelids furnished with very long lashes; the cheekbones are usually high; the hair straight; the beard almost entirely wanting, as in the same people, from whom, however, they differ essentially in having the nose pretty long. The mouth is wide, the lips broad but not prominent, the chin extremely short and round, and the jaws remarkable for their strength. The teeth are white and sound, the toothach being a disease with which they are seldom afflicted. The hands are small and slender, while the feet are large, and the toes possessed of an extraordinary mobility. They have so strong a family look, that on entering a hut it is often difficult, among grown-up persons, to distinguish the father from the son. This is attributable to the circumstance of their only marrying in their own tribe, as well as to their inferior degree of intellectual improvement: the differences between uncivilized and cultivated man being similar to those between wild and domesticated animals of the same species. Figure and stature.

As they live in a very warm country they are excessively averse to clothing. In spite of the remonstrances of the monks, men and women remain naked while within their houses; and, when they go out, wear only Expression.

Family likeness.

Aversion to clothing.

- CHAP. IX.** a kind of cotton gown scarcely reaching to the knees.
- Native dress.** The dress of the men has sleeves, while that of the women and boys has none, the arms, shoulders, and upper part of the breast being uncovered. Till the age of nine the girls are allowed to go to church naked. The missionaries complain that the feeling of modesty is very little known to the younger of the sex. The women are not handsome ; but the maidens have a kind of pleasant melancholy in their looks. No instances of natural deformity occurred to the travellers. Humboldt remarks, that deviations from nature are exceedingly rare among certain races of men, especially such as have the skin highly coloured,—an effect which he does not ascribe solely to a luxurious life or the corruption of morals, but rather imagines that the immunity enjoyed by the American Indians arises from hereditary organization. The custom of marrying at a very early age, which depends upon the same circumstance, is stated to be no way detrimental to population. It occurs in the most northern parts of the continent as well as in the warmest, and therefore is not dependent upon climate.
- Customs and habits of life.**
- Hair.** They have naturally very little hair on the chin, and the little that appears is carefully plucked out. This thinness of the beard is common to the American race, although there are tribes, such as the Chipeways and the Patagonians, in which it assumes respectable dimensions.
- Regularity of life.** The Chaymas lead a very regular and uniform life. They go to bed at seven and rise at half after four. The inside of their huts is kept very clean, and their hammocks, utensils, and weapons, are arranged in the greatest order. They bathe every day, and, being generally naked, are thus exempted from the filth principally caused by clothing. Besides their cabin in the village, they usually have a smaller one, covered with palm or plantain leaves, in some solitary place in the woods, to which they retire as often as they can ; and so strong is the desire among them of enjoying the pleasures of savage life, that the children sometimes wander entire

days in the forests. In fact the towns are often almost wholly deserted. As in all semi-barbarous nations, the women are subjected to privation and suffering, the hardest labour falling to their share. CHAP. IX.

The Indians learn Spanish with extreme difficulty; and, even when they perfectly understand the meaning of the words, are unable to express the most simple ideas in that language without embarrassment. They seem to have as little capacity for comprehending any thing belonging to numbers; the more intelligent counting in Spanish with the appearance of great effort only as far as thirty, or perhaps fifty, while in their own tongue they cannot proceed beyond five or six. The construction of the American dialects is so different from that of the several classes of speech derived from the Latin, that the Jesuits employed some of the more perfect among the former instead of their own; and had this system been generally followed the greatest benefit would have resulted from it. The Chayma appeared to Humboldt less agreeable to the ear than that of the other South American tribes. Knowledge
of Spanish.
Native
dialects.

The Pariagotos, or Parias, formerly occupied the coasts of Berbice and Essequibo, the peninsula of Paria, and the plains of Piritoo and Parima. Little information, however, is furnished respecting them. Parias.

The Guaraunos are dispersed in the delta of the Orinoco, and owe their independence to the nature of their country. In order to raise their houses above the inundations of the river, they support them on the trunks of the mangrove and mauritia palm. They make bread of the flour obtained from the pith of the latter tree. Their excellent qualities as seamen, their perfect knowledge of the mouths and inosculation of that magnificent stream, and their great number, give them a certain degree of political importance. They run with great address on marshy ground, where the whites, the negroes, or other Indian tribes, will not venture; and this circumstance has given rise to the Guaraunos.

- CHIAP. IX** idea of their being specifically lighter than the rest of the natives.
- Guayquerias.** The Guayquerias are the most interpid fishermen of these countries, and are the only persons well acquainted with the great bank that surrounds the islands of Coche, Margarita, Sola, and Testigos. They inhabit Margarita, the peninsula of Araya, and a suburb of Cumana.
- Quaquas.** The Quaquas, formerly a very warlike tribe, are now mingled with the Chaymas attached to the missions of Cumana, although their original abode was on the banks of the Assiveru.
- Cumana-gotos.** The Cumanagotos, to the number of more than twenty-six thousand, subject to the Christian stations of Piritoo, live westward of Cumana, where they cultivate the ground. At the beginning of the sixteenth century they inhabited the mountains of the Brigantine and Parabolota.
- Caribbees.** The Caribbees of these countries are part of the remnant of the great Carib nation.
- Natives of America.** The natives of America may be divided into two great classes. To the first belong the Esquimaux of Greenland, Labrador, and Hudson's Bay, and the inhabitants of Behring's Straits, Alaska, and Prince William's Sound. The eastern and western branches of this great family, the Esquimaux proper and the Tchougazes, are united by the most intimate similarity of language, although separated to the immense distance of eight hundred leagues. The inhabitants of the north-east of Asia are evidently of the same stock. Like the Malays, this hyperborean nation resides only on the seacoast. They are lively and loquacious, and of smaller stature than the other Americans. Their hair is straight and black; but their skin is originally white, in which respect they essentially differ from the other class.
- The second race is dispersed over the various regions of the continent, from the northern parts to the southern extremity. They are of larger size, more warlike, and more taciturn, and differ in the colour of their skin.

At the earliest age it has more or less of a coppery tinge (CHAP. IX. in most of the tribes, while in others the children are fair, or nearly so ; and certain tribes on the Orinoco preserve the same complexion during their whole life. Humboldt is of opinion that these differences in colour are but slightly influenced by climate or other external circumstances, and endeavours to impress the idea that they depend on the original constitution.

CHAPTER X.

Residence at Cumana.

Residence at Cumana—Attack of a Zambo—Eclipse of the Sun—
Extraordinary Atmospherical Phenomena—Shocks of an Earth-
quake—Luminous Meteors.

CHAP. X. OUR travellers remained a month longer at Cumana.

Residence at Cumana. As they had determined to make a voyage on the Orinoco and Rio Negro, preparations of various kinds were necessary ; and the astronomical determination of places being the most important object of this undertaking, it was of essential advantage to observe an eclipse of the sun which was to happen in the end of October.

Assault on Bonpland. On the 27th, the day before the obscuration, they went out in the evening, as usual, to take the air. Crossing the beach which separates the suburb of the Guayquerias from the landing-place, they heard the sound of footsteps behind, and on turning saw a tall Zambo, who, coming up, flourished a great palm-tree-bludgeon over Humboldt's head. He avoided the stroke by leaping aside ; but Bonpland was less fortunate, for, receiving a blow above the temple he was felled to the ground. The former assisted his companion to rise, and both now pursued the ruffian, who had run off with one of their hats, and on being seized, drew a long knife from his trousers. In the mean time some Biscayan

Arrest of the Zambo. merchants, who were walking on the shore, came to their assistance ; when the Zambo, seeing himself surrounded, took to his heels and sought refuge in a sowhouse, from which he was led to prison. The in-

REMARKABLE ATMOSPHERIC PHENOMENA. 107

habitants showed the warmest concern for the strangers, and although Bonpland had a fever during the night he speedily recovered. The object of the Zambo, who soon afterwards succeeded in escaping from the castle of San Antonio, was never satisfactorily made out. CHAP. X.

Notwithstanding this untoward accident Humboldt was enabled to observe the eclipse. The days which preceded and followed it displayed very remarkable atmospheric phenomena. It was what is called winter in those countries. From the 10th of October to the 3d of November a reddish vapour rose in the evening, and in a few minutes covered the sky. The hygrometer gave no indication of humidity. The diurnal heat was from 82.4° to 89.6°. Sometimes in the midst of the night the mist disappeared for a moment, when clouds of a brilliant whiteness formed in the zenith, and extended towards the horizon. On the 18th of October they were so transparent that they did not conceal stars even of the fourth magnitude, and the spots of the moon were very clearly distinguished. They were arranged in masses at equal distances, and seemed to be at a prodigious height. From the 28th of October to the 3d of November the fog was thicker than it had yet been. The heat at night was stifling, although the thermometer indicated only 78.8°. The evening breeze was no longer felt; the sky appeared as if on fire, and the ground was every where cracked and dusty. On the 4th of November, about two in the afternoon, large clouds of extraordinary blackness enveloped the mountains of the Brigantine and Tataraqual, extending gradually to the zenith. About four, thunder was heard overhead, but at an immense height, and with a dull and often interrupted sound. At the moment of the strongest electric explosion, two shocks of an earthquake, separated by an interval of fifteen seconds, were felt. The people in the streets filled the air with their cries. Bonpland, who was examining plants, was nearly thrown on the floor, and Humboldt, who was lying in his hammock, felt the concussion strongly. Its direction was from north to

Eclipse of
the sun.

Atmospheric
phenomena.

Remarkable
clouds.

Earthquake.

CHAP. X.

south. A few minutes before the first, there was a violent gust of wind followed by large drops of rain. The sky remained cloudy, and the blast was succeeded by a dead calm which continued all night. The setting of the sun presented a scene of great magnificence. The dark atmospheric shroud was rent asunder close to the horizon, and the sun appeared at 12° of altitude on an indigo ground, its disk enormously enlarged and distorted. The clouds were gilded on the edges, and bundles of rays reflecting the most brilliant prismatic colours extended over the heavens. About nine in the evening there was a third shock, which, although much slighter, was evidently attended with a subterranean noise. The barometer was a little lower than usual, but the progress of the horary variations was in no way interrupted. In the night, between the 3d and 4th of November, the red vapour was so thick that the place of the moon could be distinguished only by a beautiful halo, 20° in diameter.

Popular apprehension.

Scarcely twenty-two months had elapsed since the almost total destruction of Cumana by an earthquake; and as the people look on the vapours, and the failure of the breeze during the night, as prognostics of disaster, the travellers had frequent visits from persons desirous of knowing whether their instruments indicated new shocks on the morrow. On the 5th, precisely at the same hour, the same phenomena recurred, but without any agitation; and the gust accompanied by thunder returned periodically for five or six days.

Impression on Humboldt.

This earthquake, being the first that Humboldt ever felt, made a strong impression upon him; but scenes of this kind afterwards became so familiar as to excite little apprehension. It appeared to have a sensible influence on the magnetical phenomena. Soon after his arrival on the coasts of Cumana, he found the dip of the needle $43^{\circ}53'$ of the centesimal division. On the 1st of November it was $43^{\circ}65'$. On the 7th, three days after the concussion, he was astonished to find it no more than $42^{\circ}75'$, or 90 centesimal minutes less. A year

later, on his return from the Orinoco, he still found it 42-80°, though the intensity of the magnetic forces remained the same after as before the event under consideration, being expressed by 229 oscillations in ten minutes of time. On the 7th November he observed the magnetic variation to be 4° 13' 50" E.

CHAP. X.
Magnetic
phenomena.

The reddish vapour which appeared about sunset ceased on the 7th of November. The atmosphere then assumed its former purity; and the night of the 11th was cool and extremely beautiful. Towards morning a very extraordinary display of luminous meteors was observed in the east by M. Bonpland, who had risen to enjoy the freshness of the air in the gallery. Thousands of fire-balls and falling-stars succeeded each other during four hours, having a direction from north to south, and filling a space of the sky extending from the true east 30 degrees on either side. They rose above the horizon at E.N.E. and at E., described arcs of various sizes, and fell toward S., some attaining a height of 40°, and all exceeding 25° or 30°. No trace of clouds was to be seen, and a very slight easterly wind blew in the lower regions of the atmosphere. All the meteors left luminous traces from five to ten degrees in length, the phosphorescence of which lasted seven or eight seconds. The fire-balls seemed to explode, but the largest disappeared without scintillation; and many of the falling-stars had a very distinct nucleus, as large as the disk of Jupiter, from which sparks were emitted. The light occasioned by them was white,—an effect which must be attributed to the absence of vapours; stars of the first magnitude having, within the tropics, a much paler hue at their rising than in Europe.

Meteora.

Course of
fire-balls.

Light.

As the inhabitants of Cumana leave their houses before four to attend the first morning mass, most of them were witnesses of this phenomenon, which gradually ceased soon after, although some were still perceived a quarter of an hour after sunrise.

The day of the 12th November was exceedingly hot, and in the evening the reddish vapour reappeared in the

CHAP. X. horizon, and rose to the height of 14° . This was the last time it was seen that year.

Researches
regarding
the meteors

The researches of M. Chladni having directed the attention of the scientific world to fire-balls and falling-stars at the period of Humboldt's departure from home, he did not fail to inquire, during his journey from Caraccas to the Rio Negro, whether the meteors of the 12th November had been seen. He found that they had been observed by various individuals in places very remote from each other; and on returning to Europe was astonished to find that they had been seen there also. The following is a brief account of the facts relating to these phenomena:—1st, The luminous meteors were seen in the E. and E.N.E. at 40° of elevation, from two to six A.M., at Cumana, in lat $10^{\circ} 27' 52''$, long. $64^{\circ} 10'$; at Porto Cabello, in lat. $10^{\circ} 6' 52''$, long. $64^{\circ} 45'$; and on the frontiers of Brazil, near the equator, in long. $67^{\circ} 40'$ west. 2dly, The Count de Marbois observed them in French Guiana, lat. $4^{\circ} 56'$, long. $52^{\circ} 15'$. 3dly, Mr Ellicot, astronomer to the United States, being in the Gulf of Florida on the 12th November, saw an immense number of meteors, some of which appeared to fall perpendicularly; and the same phenomenon was perceived on the American continent as far as lat. $30^{\circ} 42'$. 4thly, In Labrador, in lat. $56^{\circ} 55'$, and lat. $58^{\circ} 4'$; in Greenland, in latitudes $61^{\circ} 5'$ and $64^{\circ} 14'$, the natives were frightened by the vast quantity of fire-balls that fell during twilight, some of them of great size. 5thly, In Germany, Mr Zeissing, vicar of Itterstadt near Weimar, in lat. $50^{\circ} 59'$, long. $11^{\circ} 21' E.$, observed, between six and seven in the morning of the 12th November, some falling-stars having a very white light. Soon after reddish streaks appeared in the S. and S.W.; and at dawn the south-western part of the sky was from time to time illuminated by white lightning running in serpentine lines along the horizon.

Facts noted.

Calculations.

Calculating from these facts, it is manifest that the height of the meteors was at least 1419 miles; and, as near Weimar they were seen in the S. and S.W., while

at Cumana they were observed in the E. and N.E., we must conclude that they fell into the sea between Africa and South America, to the west of the Cape Verd Islands. CHAP. X.
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Without entering into the learned discussion, which Humboldt submits to his readers, respecting the nature of these luminous bodies, we shall merely observe, that he found falling-stars more frequent in the equinoctial regions than in the temperate zone, and also that they occurred oftener over continents and near certain coasts than on the ocean. He states that on the platform of the Andes there was observed, upwards of thirty years before, a phenomenon similar to that related above as having occurred at Cumana. From the city of Quito an immense number of meteors was seen rising over the volcano of Cayambo, insomuch that the whole mountain was thought to be on fire. They continued more than an hour, and a religious procession was about to be commenced, when the true nature of the luminous appearance was discovered. Further
results of
observations.

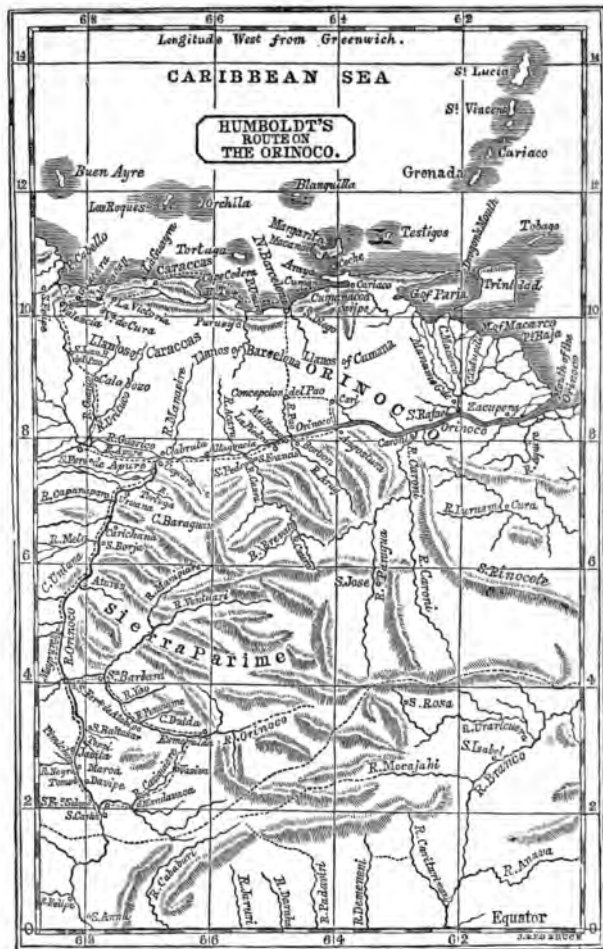
CHAPTER XI.

Voyage from Cumana to Guayra.

Passage from Cumana to La Guayra—Phosphorescence of the Sea—
Group of the Caraccas and Chimanas—Port of New Barcelona—
La Guayra—Yellow fever—Coast and Cape Blanco—Road from
La Guayra to Caraccas.

CHAP. XI. HAVING completed the partial investigations which their
Preparations short residence admitted, and having in some measure
for leaving become acclimatized, the adventurous philosophers pre-
Cumana. pared to leave Cumana. Passing by sea to La Guayra,
they intended to take up their abode in the town of
Caraccas until the rainy season should be over; from
thence to traverse the Llanos, or great plains, to the
missions of the Orinoco; to go up that river as far as
the Rio Negro; and to return to Cumana by Angostura,
the capital of Spanish Guiana.

Departure. On the 18th November, at eight in the evening, they
took their passage in one of the boats which trade
between these coasts and the West India Islands. They
are thirty-two feet long, three feet high at the gunwale,
without decks, and generally carry from 200 to 250
quintals (181 to 226 cwts. avoirdupois). Although the
sea is very rough from Cape Codera to La Guayra, and
these boats have an enormous triangular sail, there had
not been an instance for thirty years of the loss of one of
them on the passage from Cumana to Caraccas, so great
is the skill of the Guayqueria pilots. They descended
the Manzanares with rapidity, delighted with the sight
of its marginal cocoa-trees, and the glitter of the thorny



bushes covered with noctilucous insects, and left with regret a country in which every thing had appeared new and marvellous. Passing at high water the bar of the river, they entered the Gulf of Cariaco, the surface of which was gently rippled by the evening breeze. In a short time the coasts were recognised only by the scattered lights of the Indian fishermen.

CHAP. XI.

Descent of
the Man-
zanara.

As they advanced toward the shoal that surrounds Cape Arenas, stretching as far as the petroleum springs of Maniquarez, they enjoyed one of those beautiful sights which the phosphorescence of the sea so often displays in tropical climates. When the porpoises, which followed the boat in bands of fifteen or sixteen, struck the surface of the water with their tails, they produced a brilliant light resembling flames. Each troop left behind it a luminous track; and as few sparks were caused by the motion of an oar or the track of the boat, Humboldt conjectured that the vivid glow produced by these cetaceous animals was owing not to the stroke of their tails alone, but also to the gelatinous matter which envelops their bodies, and which is detached by the waves.

Cape Arenas.

At midnight they found themselves among some rocky islets, rising in the form of bastions, and constituting the group of the Caraccas and Chimanas. Many of these eminences are visible from Cumana, and present the most singular appearances under the effect of mirage. Their height, which is probably not more than 960 feet, seemed much greater when enlightened by the moon, which now shone in a clear sky. The travellers were becalmed in the neighbourhood of these islands, and at sunrise drifted towards Boracha, the largest of them. The temperature had sensibly increased, in consequence of the rocks giving out by radiation a portion of the heat which they had absorbed during the day. As the sun rose, the cliffs projected their lengthened shadows upon the ocean, and the flamingoes began to fish in the creeks. These insular spots were all uninhabited; but on one of them, which

The Caraccas
and Chi-
manas.Increased
temperature.

CHAP. XI. had formerly been the residence of a family of whites, there were wild goats of a large size and brown colour. The inhabitants had cultivated maize and cassava; but the father, after the death of his children, having purchased two black slaves, was murdered by them. One of the assassins subsequently informed against his accomplice, and at the time of Humboldt's visit was hangman at Cumana.

New Barcelona.

Commerce of the port.

Proceeding onwards they anchored for some hours in the road of New Barcelona, at the mouth of the river Neveri, which is full of crocodiles. These animals, especially in calm weather, occasionally make excursions into the open sea,—a fact which is interesting to geologists, on account of the mixture of marine and fresh-water organic remains that are occasionally observed in some of the more recent deposits. The port of Barcelona had at that time a very active commerce, arising from the demand in the West Indies for salted provision, oxen, mules, and horses; the merchants of the Havannah being the principal purchasers. Its situation is extremely favourable for this exportation, the animals arriving in three days from the Llanos, while they take more than double that time to reach Cumana, on account of the chain of mountains which they have to cross. Eight thousand mules were embarked at Barcelona, six thousand at Porto Cabello, and three thousand at Carupano, in 1799 and 1800, for the several islands.

Morro de Barcelona.

Landing on the right bank of the river, they ascended to a small fort, the Morro de Barcelona, built on a calcareous rock, at an elevation of about 400 feet above the sea, but commanded by a much higher hill on the south. Here they observed a very curious geological phenomenon, which recurred in the cordilleras of Mexico. The limestone, which had a dull, even, or flat conchoidal fracture, and was divided into very thin strata, was traversed by layers of black slaty jasper, with a similar fracture, and breaking into fragments having a parallelipedal form. It did not exhibit the

little veins of quartz so common in Lydian stone, and was decomposed at the surface into a yellowish-gray crust. CHAP. XI

Setting sail on the 19th at noon, they found the temperature of the sea at its surface to be 78·6°; but when passing through the narrow channel which separates the Piritos, in three fathoms it was only 76·1°. These islands do not rise more than eight or nine inches above the mean height of the tide, and are covered with long grass. To the westward of the Morro de Barcelona and the mouth of the river Unare, the ocean became more and more agitated as they approached Cape Codera, the influence of which extends to a great distance. Beyond this promontory it always runs very high, although a gale of wind is never felt along this coast. It blew fresh during the night, and on the 20th, at sunrise, they were so advanced as to be in expectation of doubling the Cape in a few hours; but some of the passengers having suffered from sea-sickness, and the pilot being apprehensive of danger from the privateers stationed near La Guayra, they made for the shore, and anchored at nine o'clock in the Bay of Iliguerota, westward of the Rio Capaya. Temperature of the sea.

On landing, they found two or three huts inhabited by mestizo fishermen, the livid tint of whom, together with the miserable appearance of their children, gave indication of the unhealthy nature of the coast. The sea is so shallow that one cannot go ashore in the smallest boat without wading. The woods come nearly to the beach, which is covered with mangroves, avicennias, manchineel-trees, and *Suriana maritima*, called by the natives *romero de la mar*. Here as elsewhere the insalubrity of the air is attributed to the exhalations from the first of these plants. A faint and sickly smell was perceived, resembling that of the galleries of deserted mines. The temperature rose to 93·2°, and the water along the whole coast acquired a yellowish-brown tint wherever it was in contact with these trees. Bay of Iliguerota.

Struck by this phenomenon, Humboldt gathered a

CHAP. XI.

The mangrove.

Experiments.

Observations of Humboldt.

considerable quantity of branches and roots with the view of making experiments on the mangrove upon his arrival at Caraccas. The infusion in warm water was of a brown colour, and had an astringent taste. It contained extractive matter and tannin. When kept in contact with atmospheric air under a glass jar for twelve days, the purity of the latter was not perceptibly affected. The wood and roots placed under water were exposed to the rays of the sun. Bubbles of air were disengaged, which at the end of ten days amounted to a volume of 40 cubic inches. These consisted of azote and carbonic acid, with a trace of oxygen. Lastly, the same substances thoroughly wetted were enclosed with a given volume of atmospheric air in a phial. The whole of the oxygen disappeared. These experiments led him to think that it is the moistened bark and fibre that act upon the atmosphere, and not the brownish water which formed a distinct belt along the coast. Many travellers attribute the smell perceived among mangroves to the disengagement of sulphuretted hydrogen; but no appearance of this kind was observed in the course of these investigations.

“Besides,” says Humboldt, “a thick wood covering a muddy ground would diffuse noxious exhalations in the atmosphere, were it composed of trees which in themselves have no deleterious property. Wherever mangroves grow on the margin of the sea, the beach is peopled with multitudes of mollusca and insects. These animals prefer the shade and a faint light; and find shelter from the waves among the closely interlaced roots which rise like lattice-work above the surface of the water. Shells attach themselves to the roots, crustaceous animals nestle in the hollow trunks, the seaweeds which the wind and tide drive upon the shore remain hanging upon the recurved branches. In this manner the maritime forests, by accumulating masses of mud among their roots, extend the domain of the continents; but, in proportion as they gain upon the sea, they scarcely experience any increase in breadth, their

very progress becoming the cause of their destruction. CHAP. XI.
 The mangroves and the other plants with which they ^{Mangrove} always associate die as the ground dries, and when the ^{forests.} salt water ceases to bathe them. Centuries after, their decayed trunks, covered with shells, and half buried in the sand, mark both the route which they have followed in their migrations, and the limit of the land which they have wrested from the ocean."

Cape Codera, seven miles distant from the bay of ^{Cape} ^{Codera} Niguerota, is more imposing on account of its mass than for its elevation, which appeared to be only 1280 feet. It is precipitous on the north, west, and east. Judging from the fragments of rock found along the coast, and from the hills near the town, it is composed of foliated gneiss, containing nodules of reddish felspar, and little quartz. The strata next the bay have the same dip and direction as the great mountain of the Silla, which stretches from Caraccas to Maniquarez in the Isthmus of Araya, and seem to prove that the primitive chain forming that neck of land, after being disrupted or swallowed up by the sea along an extent of 121 miles, reappears at Cape Codera, and runs westward in an unbroken line. Toward the north the cape forms an immense segment of a sphere, and at its foot stretches a tract of low land, known to navigators by the name of the Points of Tutumo and of San Francisco.

The passengers in the boat dreaded the rolling in a ^{Change of} rough sea so much that they resolved to proceed to ^{plans.} Caraccas by land, and M. Bonpland, following their example, procured a rich collection of plants. Humboldt, however, continued the voyage, as it seemed hazardous to lose sight of the instruments.

Setting sail at the beginning of the night, they ^{English} doubled Cape Codera with difficulty, the wind being ^{frigate.} unfavourable, and the surges short and high. On the 21st of November, at sunrise, they were opposite Curuaio, to the west of the cape. The Indian pilot was frightened at seeing an English frigate only a mile distant; but they escaped without attracting notice. The moun-

CHAP. XI
Precipitous
mountains.

tains were every where precipitous, and from 3200 to 4300 feet high, while along the shore was a tract of low humid land, glowing with verdure, and producing a great part of the fruits found so abundantly in the neighbouring markets. The peaks of Niguatar and the Silla of Caraccas form the loftiest summits of this chain. In the fields and valleys the sugar-cane and maize are cultivated. To the west of Caravalleda the declivities along shore are again very steep. After passing this place they discovered the village of Macuto, the black rocks of La Guayra covered with batteries, and in the distance the long promontory of Cape Blanco, with conical summits of dazzling whiteness.

Arrival at
Caraccas.

Humboldt landed at Guayra, and in the evening arrived at Caraccas, four days sooner than his fellow-travellers, who had suffered greatly from the rains and inundations. The former he describes as rather a road than a port, the sea being always agitated, and ships suffering from the action of the wind, the tideways, the bad anchorage, and the worms. The lading is taken in with difficulty. The free mulattoes and negroes, who carry the cocoa on board the ships, are remarkable for their strength. They go through the water up to their middles, although this place abounds in sharks, from which, however, they have in reality nothing to dread. It is singular, that while these animals are dangerous and bloodthirsty at the island opposite the coast of Caraccas, at the Roques, at Buenos Ayres, and at Curassao, they do not disturb persons swimming in the ports of Guayra and Santa Martha. As an analogous fact, Humboldt mentions that the crocodiles of one pool in the Llanos are cowardly, while those of another attack with the greatest fierceness.

Sharks.

La Guayra.

The situation of La Guayra resembles that of Santa Cruz in Teneriffe; the houses, which are built on a flat piece of ground about 640 feet broad, being backed by a wall of rock, beyond which is a chain of mountains. The town consists of two parallel streets, and contains 6000 or 8000 inhabitants. The heat is greater than

even at Cumana, Porto Cabello, or Coro, the sea-breeze being less felt, and the temperature being increased by the radiant caloric emitted by the rocks after sunset. CHAP. XI.

The examination of the thermometrical observations, made at La Guayra during nine months by Don Joseph Herrera, enabled Humboldt to compare the climate of that port with those of Cumana, Havannah, and Vera Cruz. The result of this comparison was, that the first mentioned is one of the hottest places on the globe; that the quantity of heat which it receives in the course of a year is a little greater than that experienced at Cumana; but that in November, December, and January, the atmosphere cools to a lower point. The mean temperature of the year in these several districts is as follows:—At La Guayra, nearly 82·6°; at Cumana, 81·8°; at Vera Cruz, 77·7°; at Havannah, 78·1°; while at Rio Janeiro it is 74·3°; at Santa Cruz in Teneriffe, 71·4°; at Cairo, 72·3°; and at Rome, 60·4°. Thermometrical observations.

At the time of Humboldt's visit to La Guayra, the yellow fever, or *calentura amarilla*, had been known only two years there, and the mortality had not been very great, as the confluence of strangers was less than at Havannah and Vera Cruz. Some individuals, even Creoles and mulattoes, were occasionally taken off by remittent attacks, complicated with bilious symptoms and hemorrhages, and their death often alarmed unseasoned Europeans; but the disease was not propagated. On the coast of Terra Firma this malignant typhus was known only at Porto Cabello, Carthagena, and Santa Martha. But since 1797 things have changed. The extension of commerce having caused an influx of Europeans and seamen from the United States, the distemper in question soon appeared. It is maintained by some, that it was introduced by a brig from Philadelphia; while others think it took its birth in the country itself, and attribute its origin to a change in the constitution of the atmosphere caused by the overflowings of the Rio de la Guayra, which inundated the town. This fever has since continued its ravages, and Causes of the distemper.

CHAP. XI. has proved fatal not only to troops newly arrived from Spain, but also to those raised far from the coast, in the Llanos, between Calabozo and Uritucu, a region nearly as hot as La Guayra itself. It scarcely ever passes beyond the ridge of mountains that separates this province from the valley of Caraccas, which has long been exempted from it. The following are the principal pathological facts having reference to this frightful pestilence :—

Pathological facts.

When a great number of persons, born in a cold climate, arrive at a port in the torrid zone, the insalubrity of which has not been particularly dreaded by navigators, the American typhus (black vomiting, or yellow fever) makes its appearance. These persons, we may add, are not affected by it during the passage ; it manifests itself only on the spot. Has the constitution of the atmosphere been changed ? asks Humboldt ; or, has a new form of disease developed itself in individuals whose excitability is raised to a high pitch ?

Spread of the disease.

The malady forthwith attacks other Europeans born in warmer countries. Immediate contact does not increase the danger, nor does seclusion diminish it. When the sick are removed to the interior, and especially to cooler and more elevated places, they do not communicate the typhus to the inhabitants. Whenever a considerable diminution of temperature occurs, the distemper usually ceases ; but it again begins at the commencement of the hot season, although no ship may have entered the harbour for several months.

At Havannah and Vera Cruz.

The yellow fever disappears periodically at Havannah and at Vera Cruz, when the north winds carry the cold air of Canada towards the Mexican Gulf ; but as Porto Cabello, La Guayra, New Barcelona, and Cumana, possess an extreme equality of temperature, it is probable that it will become permanent there. Happily, the mortality has diminished since the treatment has been varied according to the modifications which the disease assumes. In well managed hospitals, the number of deaths is often reduced to eighteen or fifteen in a hun-

dred ; but when the sick are crowded together, the loss increases to one-half or even more. CHAP. XI

To the west of La Guayra there are several indentations of the land which furnish excellent anchorage. The coast is granitic, and a great portion of it extremely unhealthy. At Cape Blanco the gneiss passes into mica-slate, containing beds of chlorite-slate, in which garnets and magnetic sand occur. On the road to Catia the chlorite-slate is seen passing into hornblende-slate. At the foot of the promontory the sea throws on the beach rolled fragments of a granular mixture of hornblende and felspar, in which traces of quartz and pyrites are recognised. On the western declivity of that hill the gneiss is covered by a recent sandstone or conglomerate, in which are observed angular fragments of gneiss, quartz, and chlorite, magnetic sand, madrepores, and bivalve shells. The latitude of the Cape is $10^{\circ} 36' 45''$; that of La Guayra is $10^{\circ} 36' 19''$, its longitude $67^{\circ} 5' 49''$. Character of the coast.

The road from La Guayra to Caraccas resembles the passages over the Alps ; but, as it is kept in tolerable repair, it requires only three hours to go with mules from the port to the capital, and two hours to return. The ascent commences with a ridge of rocks, and is extremely laborious. In the steepest parts the path winds in a zigzag manner. At the *Salto*, or *Leap*, there is a crevice which is passed by a drawbridge, and on the summit of the mountain are fortifications. Half-way is *La Venta* (the *Inn*) ; beyond which there is a rise of 960 feet to Guayavo, which is not far from the highest part of the route. At the fort of La Cuchilla, Humboldt was nearly made prisoner by some Spanish soldiers, whom he, however, contrived to pacify. Round the little inn several travellers were assembled, who were disputing on the efforts that had been made towards obtaining independence ; on the hatred of the mulattoes against the free negroes and whites ; the wealth of the monks ; and on the difficulty of holding slaves in obedience. From Guayavo the road passes over a smooth Road to Caraccas.

La Venta.

CHAP. XI table-land covered with Alpine plants ; and here is seen for the first time the capital, standing nearly 2000 feet ower, in a beautiful valley enclosed by lofty mountains.

Avilla.

The ridges between La Guayra and Caraccas consist of gneiss. On the south side, the eminence which bears the name of Avilla is traversed by veins of quartz, containing rutile titanite in prisms of two or three lines in diameter. The gneiss of the intervening valley contains red and green garnets, which disappear when the rock passes into mica-slate. Near the cross of La Guayra, half a league distant from Caraccas, there were vestiges of blue copper-ore disseminated in veins of quartz, and small layers of graphite. Between the former point and the spring of Sanchorquiz were beds of bluish-gray primitive limestone, containing mica, and traversed by veins of white calcareous spar. In this deposite were found crystals of pyrites and rhomboidal fragments of sparry iron-ore.

CHAPTER XII.

City of Caraccas and surrounding District.

City of Caraccas—General View of Venezuela—Population—Climate—Character of the Inhabitants of Caraccas—Ascent of the Silla—Geological Nature of the District, and the Mines.

CARACCAS, the capital of the former captain-generalship of Venezuela, is more known to Europeans on account of the earthquakes by which it was desolated than from its importance in a political or commercial point of view. At the present day it is the chief city of a district of the same name, forming part of the republic of Columbia; though, at the time of Humboldt's visit, it was the metropolis of a Spanish colony which contained nearly a million of inhabitants, and consisted of New Andalusia or Caraccas, Coro, and Maracaybo, along the coast; and in the interior, the provinces of Varinas and Guiana.

In a general point of view Venezuela presents three distinct zones. Along the shore, and near the chain of mountains which skirts it, we find cultivated land; behind this, savannahs or pasturages; and beyond the Orinoco, a mass of forests, penetrable only by means of the rivers by which it is traversed. In these three belts, the three principal stages of civilisation are found more distinct than in almost any other region. We have the life of the wild hunter in the woody district—the pastoral life in the savannahs—and the agricultural in the valleys and plains which descend to various parts of the

CHAP. XII
City of
Caraccas.

Venezuela.

CHAP. XII coast. Missionaries and a few soldiers occupy advanced posts on the southern frontiers. In this section are felt the preponderance of force and the abuse of power. The native tribes are engaged in perpetual hostilities; the monks endeavour to augment the little villages of their missions by availing themselves of the dissensions of the Indians; and the soldiers live in a state of war with the clergy. In the second division, that of the plains and prairies, where food is extremely abundant, little advance has been made in civilisation, and the inhabitants live in huts partly covered with skins. It is in the third district alone, where agriculture and commerce are pursued, that society has made any progress.

Constitution
of the states.

In following our travellers through these interesting countries, it is necessary that we lose sight in some measure of the present constitution of the South American states, and view them simply as Spanish provinces. When we seek, says Humboldt, to form a precise idea of those vast regions, which for ages have been governed by viceroys and captains-general, we must fix our attention on several points. We must distinguish the parts of Spanish America that are opposite to Asia, and those that are washed by the Atlantic,—we must observe where the greatest part of the population is placed, whether near the coast or in the interior, or on the table-lands of the Cordilleras,—we must determine the numerical proportions between the natives and other inhabitants, and examine to what race, in each part of the colonies, the greater number of whites belong. The inhabitants of the different districts of the mother-country preserve in some measure their moral peculiarities in the New World, although they have undergone various modifications depending upon the physical constitution of their new abode.

Venezuela.

In Venezuela, whatever is connected with an advanced state of civilisation is found along the coast, which has an extent of more than seven hundred miles. It is washed by the Caribbean Sea, a kind of Mediterranean, on the shores of which almost all the European nations

have founded colonies, and which communicates at several points with the Atlantic Ocean. Possessing much facility of intercourse with the inhabitants of other parts of America, and with those of Europe, the natives have acquired a great degree of knowledge and opulence. CHAP. XII

The Indians constitute a large proportion of the agricultural residents in those places only where the conquerors found regular and long established governments, as in New Spain and Peru. In the province of Caraccas, for example, the native population is inconsiderable, having been in 1800 not more than one-ninth of the whole, while in Mexico it formed nearly one-half. The black slaves do not exceed one-fifteenth of the general mass, whereas in Cuba they were in 1811 as one to three, and in other West India islands still more numerous. In the Seven United Provinces of Venezuela, there were 60,000 slaves; while Cuba, which has but one-eighth of the extent, had 212,000. The blacks of these countries are so unequally distributed, that in the district of Caraccas alone there were nearly 40,000, of which one-fifth were mulattoes. Humboldt estimates the Creoles, or Hispano-Americans, at 210,000 in a population of 900,000, and the Europeans, not including troops, at 12,000 or 15,000.

Caraccas was then the seat of an audiencia, or high court of justice, and one of the eight archbishoprics into which Spanish America was divided. Its population in 1800 was about 40,000. In 1766 great devastation was made by the small-pox, from 6000 to 8000 individuals having perished; but since that period inoculation has become general. In 1812 the inhabitants amounted to 50,000, of which 12,000 were destroyed by the earthquakes; while the political events which succeeded that catastrophe reduced their number to less than twenty thousand.

The town is situated at the entrance of the valley of Chacao, which is ten miles in length, eight and a half miles in breadth, and about 2650 feet above the level of

CHAP. XII
Foundation
of Caraccas.

the sea. The ground occupied by it is a steep uneven slope. It was founded by Diego de Losada in 1567. Three small rivers descending from the mountains traverse the line of its direction; it contained eight churches, five convents, and a theatre capable of holding 1500 or 1800 persons. The streets were wide, and crossed each other at right angles; the houses spacious and lofty.

The small extent of the valley, and the proximity of the mountains of Avila and the Silla, give a stern and gloomy character to the scenery, particularly in November and December, when the vapours accumulate towards evening along the high grounds; in June and July, however, the atmosphere is clear, and the air pure and delicious. The two rounded summits of the latter are seen from Caraccas, nearly under the same angle of elevation as the Peak of Teneriffe is observed from Orotava. The first half of the ascent is covered with grass; then succeeds a zone of evergreen trees; while above this the rocky masses rise in the form of domes destitute of vegetation. The cultivated region below forms an agreeable contrast to the sombre aspect of the towering ridges which overhang the town, as well as of the hills to the north.

Climate.

The climate of Caraccas is a perpetual spring, the temperature by day being between 68° and 79°, and by night between 60° and 64°. It is, however, liable to great variations, and the inhabitants complain of having several seasons in twenty-four hours, as well as a too rapid transition from one to another. In January, for example, a night of which the mean heat does not exceed 60° is followed by a day in which the thermometer rises above 71° in the shade. Although in our mild climates oscillations of this kind produce no disagreeable effects, yet in the torrid zone Europeans themselves are so accustomed to uniformity in the temperature, that a difference of a few degrees is productive of unpleasant sensations. This inconvenience is aggravated here by the position of the town in a narrow valley, which is at

one time swept by a wind from the coast, loaded with humidity, and depositing its moisture in the higher regions as the warmth increases; and at another by a dry breeze from the interior, which dissipates the vapours and unveils the mountain-summits. This inconstancy of climate, however, is not peculiar to Caraccas, but is common to the whole temperate regions near the tropics, to all places elevated from 2500 to 5000 feet above the sea. Uninterrupted serenity during a great part of the year prevails only in the low districts adjoining the sea, or on the elevated table-lands of the interior. The intermediate zone is misty and variable.

CHAP. XII
Inconvenience of the climate.

In this province the sky is generally less blue than at Cumana. The intensity of colour measured by Saussure's cyanometer was commonly 18°, and never above 20°, from November to January, while on the coasts it was from 22° to 25°. The mean temperature is estimated by Humboldt at 70° or 72°. The heat very seldom rises to 84°, and in winter it has been observed to fall as low as 52°. The cold at night is more felt on account of its being usually accompanied by a misty sky. Rains are very frequent in April, May, and June. No hail falls in the low regions of the tropics, but it is seen here every fourth or fifth year.

Temperature.

The coffee-tree is much cultivated in the valley, and the sugar-cane thrives even at a still greater height. The banana, the pine-apple, the vine, the strawberry, the quince, the apple, the peach, together with maize, pulse, and corn, grow in great perfection. But although the atmospheric constitution of this Alpine vale be favourable to diversified culture, it is not equally so to the health of the inhabitants, as the inconstancy of the weather, and the frequent suppression of cutaneous perspiration, give rise to catarrhal affections; and a European, once accustomed to the violent heat, enjoys better health in the low country, where the air is not very humid, than in the elevated and cooler districts.

Coffee-tree.

The travellers remained two months at Caraccas, where they lived in a large house in the upper part of

Residence at Caraccas.

CHAP. XII. the town, from which they had an extensive view of the mountain-plain, the ridge of the Gallipano, and the summit of the Silla. It was the season of drought, and the conflagrations intended to improve the pasturage produced the most singular effects when seen at night.

Hospitality. They experienced the greatest kindness from all classes of the inhabitants, and more especially from the captain-general of the province, M. de Guevara Vasconzelos. Caraccas being situated on the continent, and its population less mutable than that of the islands, the national manners had not undergone so material a change. Notwithstanding the increase of the blacks, says Humboldt, at Caraccas and the Havannah, we seem to be nearer Cadiz and the United States than in any other part of the New World. There was nothing to be seen of the cold and assuming air so common in Europe; on the contrary, conviviality, candour, uniform cheerfulness, and politeness of address, characterized the natives of Spanish origin. The travellers found in several families a taste for instruction, some knowledge of French and Italian literature, and a particular predilection for music. But there was a total deficiency of scientific attainments; nor had the simplest of all the physical sciences, botany, a single cultivator. Previous to 1806 there were no printing-offices in Caraccas.

Indifference of the natives. Believing that in a country which presents such enchanting views, and exhibits such a profusion of natural productions, he should find many persons well acquainted with the surrounding mountains, Humboldt yet failed to discover one individual who had visited the summit of the Silla. But the governor having ordered the proprietor of a plantation to furnish the philosophers with negro guides who knew something of the way, they prepared for the ascent.

Ascent of the Silla. As in the whole month of December the mountain had appeared only five times without clouds, and as at that season two clear days seldom succeed each other, they were advised to choose for their excursion an interval when, the clouds being low, they might hope, by

passing through them, to enter into a transparent atmosphere. They spent the night of the 2d January at a coffee-plantation near a ravine, in which the little river Chacaito formed some fine cascades. At five in the morning they set out, accompanied by slaves carrying* their instruments, and about seven reached a promontory of the Silla, connected with the body of the mountain by a narrow dike. The weather was fine and cool. They proceeded along this ridge of rocks, between two deep valleys covered with vegetation; the large, shining, and coriaceous leaves, illumined by the sun, presenting a very picturesque appearance. Beyond this point the ascent became very steep, the acclivity being often 32° to 33°. The surface was covered with short grass, which afforded no support when laid hold of, and it was impossible to imprint steps in the gneiss. The persons who had accompanied them from the town were discouraged, and at length retired.

CHAP. XII.

Departure.

Slender streaks of mist began to issue from the woods, and afforded indications of a dense fog. The familiar loquacity of the negro Creoles formed a striking contrast to the gravity of the Indians who had attended the travellers in the missions of Caripe. They amused themselves at the expense of the deserters, among whom was a young Capuchin monk, a professor of mathematics, who had promised to fire off rockets from the top of the mountain, to announce to the inhabitants of Caraccas the success of the expedition.

Creoles and
Indians.

The eastern peak being the most elevated, they directed their course to it. The depression between the two summits has given rise to the name *Silla*, which signifies a saddle. From this hollow a ravine descends towards the valley of Caraccas. This narrow opening originates near the western dome, and the eastern summit is accessible only by going first to the westward of it, straight over the promontory of the *Puerta*.

Name of
Silla.

From the foot of the cascade of Chacaito to an elevation of 6395 feet they found only savannahs or pastures,

Cascades of
Chacaito.

CHAP. XII. among which were observed two small liliaceous plants
 with yellow flowers, and some brambles. Mixed with
 the latter they expected to find a wild rose, but were
 disappointed; nor did they subsequently meet with a
 single species of that genus in any part of South
 America.

Difficulties of
 the route. Sometimes lost in the mist, they made their way with
 difficulty, and there being no path, they were obliged to
 use their hands in climbing the steep and slippery ascent.
 A vein of procelain-clay, the remains of decomposed fel-
 spar, attracted their attention. Whenever the clouds
 surrounded them the thermometer fell to 53·6°; but
 when the sky was clear it rose to 69·8°. At the height
 of 6011 feet they saw in a ravine a wood of palms,
 which formed a striking contrast with the willows scat-
 tered at the bottom of the valley.

Forest and
 plants. After proceeding four hours across the pastures they
 entered a small forest. The acclivity became less steep,
 and they observed a profusion of rare and beautiful
 plants. At the height of 6395 feet the savannahs ter-
 minate, and are succeeded by a zone of shrubs, with
 tortuous branches, rigid leaves, and large purple flowers,
 consisting of rhododendra, thibaudiæ, andromedæ, vac-
 cinia, and befarisæ.

Savannah. Leaving this little group of Alpine plants they again
 found themselves in a savannah, and climbed over part
 of the western dome, to descend into the hollow which
 separates the two summits. Here the vegetation was so
 strong and dense, that they were obliged to cut their
 way through it. On a sudden they were enveloped in
 a thick mist, and being in danger of coming inadver-
 tently upon the brink of an enormous wall of rocks,
 which on the north side descends perpendicularly to the
 depth of more than 6000 feet, were obliged to stop. At
 this point, however, the negroes who carried their pro-
 visions, and who had been detained by the recreant
 philosopher already mentioned, overtook them, when
 they made a poor repast, the negroes or the padre hav-

ing left nothing but a few olives and a little bread. The guides were discouraged, and were with difficulty prevented from returning. CHAP. XII

In the midst of the fog the electrometer of Volta, Atmospheric
electricity. armed with a smoking match, gave very sensible signs of atmospheric electricity, varying frequently from positive to negative, and this, together with the conflict of small currents of air, appeared to indicate a change of weather. It was only two in the afternoon, and they yet entertained some hope of reaching the eastern summit before sunset, and of returning to the hollow separating the two peaks, where they might pass the night. With this view they sent half of their attendants to procure a supply, not of olives but of salt beef. These arrangements were scarcely made when the east wind began to blow violently, and in less than two minutes the clouds disappeared. The obstacles presented by the vegetation gradually diminished as they approached the eastern summit, in order to attain which it was necessary to go close to the great precipice. Hitherto the gneiss had preserved its lamellar structure; but as they climbed the cone of the Silla they Geological
features. found it passing into granite, containing instead of garnets a few scattered crystals of hornblende. In three quarters of an hour they reached the top of the pyramid, which was covered with grass, and for a few minutes enjoyed all the serenity of the sky. The elevation being 8633 feet, the eye commanded a vast range or country. The slope, which extends nearly to the sea, had an angle of $53^{\circ} 28'$, though when viewed from the coast it seems perpendicular. Humboldt remarks that a precipice of 6000 or 7000 feet is a phenomenon much rarer than is usually believed, and that a rock of 1600 feet of perpendicular height has in vain been sought for among the Swiss Alps. That of the Silla is partly covered with vegetation, tufts of *befariæ* and *andromedæ* appearing as if suspended from the rock.

Seven months had elapsed since they were on the summit of the Peak of Teneriffe, where the apparent

CHAP. XII
 —
 Contrasted
 with Tenc-
 riffe.

horizon of the sea is six leagues farther distant than on the Silla ; yet, while the boundary-line was seen distinct in the former place, it was completely blended with the air in the latter. The western dome concealed the town of Caraccas ; but they distinguished the villages of Chacao and Petare, the coffee-plantations, and the course of the Rio Guayra. While they were examining the part of the sea where the horizon was well defined, and the great chain of mountains in the distant south, a dense fog arose from the plains, and they were obliged to use all expedition in completing their observations.

Bees.

When seated on the rock, employed in determining the dip of the needle, Humboldt found his hand covered by a species of hairy bee, a little smaller than the honey-bee of Europe. These insects make their nest in the ground, seldom fly, move very slowly, and are not apt to use their sting, the guides asserting that they do so only when seized by the legs.

Dip of the
 needle.

The temperature varied from 52° to 57°, according as the weather was calm or otherwise. The dip of the needle was one centesimal degree less than at Caraccas. The breeze was from the east, which might indicate that the trade-winds extend in this latitude much higher than 9600 feet. The blue of the atmosphere was deeper than on the coasts, Saussure's cyanometer indicating 26·5°, while at Caraccas it generally gave only 18° in fine dry weather. The phenomenon that most struck the travellers was the apparent aridity of the air, which seemed to increase as the mist thickened, the hygrometer retrograding and their clothes remaining dry.

Descent
 from the
 summit.

As it would have been imprudent to remain long in a dense fog, on the brink of a precipice, the travellers descended the eastern dome, and, on regaining the hollow between the two summits, were surprised to find round pebbles of quartz,—a phenomenon which perhaps indicates that the mountain has been raised by a power applied from below. Relinquishing their design of passing the night in that valley, and having again

found the path which they had cut through the wood, CHAP. XII. they soon arrived at the district of resinous shrubs, Desertion of guides. where they lingered so long collecting plants that darkness surprised them as they entered the savannah. The moon was up, but every now and then obscured by clouds. The guides who carried the instruments slunk off successively to sleep among the cliffs; and it was not until ten that the travellers arrived at the bottom of the ravine, overcome by thirst and fatigue.

During the excursion to the Silla, and in all their Indication of ores. walks in the valley of Caraccas, they were very attentive to the indication of ores which they found in the gneiss mountains. In America that rock has not hitherto been found to be very rich in metals, the most celebrated mines of Mexico and Peru being in primitive and transition slate, trap, porphyry, graywacke, and Alpine limestone. In several parts of the region now visited small quantity of gold was found disseminated in veins Gold, silver and copper ores. of quartz, sulphuretted silver, blue copper-ore, and lead-glance; but these deposits did not seem of any importance. In the group of the western mountains of Venezuela, the Spaniards, in 1551, attempted the gold mine of Buria, but the works were soon given up. In the vicinity of Caraccas some had also been wrought, but to no great extent. In short, the mines here afforded little gratification to the cupidity of the conquerors, and were almost totally abandoned; those of Arva, near San Felipe el Fuerte, being the only ones in operation when Humboldt visited the country.

In the course of their investigations the travellers Ravine of Tipe. examined the ravine of Tipe, situated in that part of the valley which opens toward Cape Blanco. The first portion of the road was over a barren and rocky soil, on which grew a few plants of *Argemone Mexicana*. On either side of the defile was a range of bare mountains, and at this spot the plain on which the town is built communicates with the coast near Catia by the valleys of Tacagua and Tipe. In the former they found some plantations of maize and plantains, and a very extensive

CHAP. XII. ^{Large} one of cactuses fifteen feet high. In the latter they _{cactusea.} met with several veins of quartz, containing pyrites, carbonated iron-ore, sulphuretted silver, and gray copper. The works that had been undertaken were superficial, and now filled up.

CHAPTER XIII.

Earthquakes of Caraccas.

Extensive Connexion of Earthquakes—Eruption of the Volcano of St Vincent's—Earthquake of the 26th March 1812—Destruction of the City—Ten Thousand of the Inhabitants killed.—Consternation of the Survivors—Extent of the Commotions.

THE valley of Caraccas, a few years after Humboldt's visit, became the theatre of one of those physical revolutions which from time to time produce violent alterations upon the surface of our planet ; involving the overthrow of cities, the destruction of human life, and a temporary agitation of those elements of nature on which the system of the universe is founded. In the narrative of his Journey to the Equinoctial Regions of the New Continent, he has recorded all that he could collect with certainty respecting the earthquake of the 26th March 1812, which destroyed the city of Caraccas, together with 20,000 inhabitants of the province of Venezuela.

When our travellers visited those countries, they found it to be a general opinion, that the eastern parts of the coasts were most exposed to the destructive effects of such concussions, and that the elevated districts, remote from the shores, were in a great measure secure ; but in 1811 all these ideas were proved groundless.

At Humboldt's arrival in Terra Firma, he was struck with the connexion which appeared between the destruction of Cumana in 1797 and the eruption of volcanoes in the smaller West India islands. A similar principle was manifested in 1812, in the case of Caraccas. From the

CHAP. XIII.
Earthquakes

False Ideas of
the natives.

CHAP. XIII

Connexion
of earth-
quakes.

beginning of 1811 till 1813, a vast extent of the earth's surface, limited by the meridian of the Azores, the valley of the Ohio, the cordilleras of New Grenada, the coasts of Venezuela, and the volcanoes of the West Indies, was shaken by subterranean commotions, indicative of a common agency exerted at a great depth in the interior of the globe. At the period when these earthquakes commenced in the valley of the Mississippi, the city of Caraccas felt the first shock in December 1811, and on the 26th of March 1812 it was totally destroyed.

Cessation of
rain.

“The inhabitants of Terra Firma were ignorant of the agitation, which on the one hand the volcano of the island of St Vincent had experienced, and on the other the basin of the Mississippi, where on the 7th and 8th of February 1812 the ground was day and night in a state of continual oscillation. At this period the province of Venezuela laboured under great drought; not a drop of rain had fallen at Caraccas, or to the distance of 311 miles around, during the five months which preceded the destruction of the capital. The 26th March was excessively hot; the air was calm and the sky cloudless. It was Holy Thursday, and a great part of the population was in the churches. The calamities of the day were preceded by no indications of danger. At seven

Commence-
ment of the
earthquake.

minutes after four in the evening the first commotion was felt. It was so strong as to make the bells of the churches ring. It lasted from five to six seconds, and was immediately followed by another shock of from ten to twelve seconds, during which the ground was in a continual state of undulation, and heaved like a fluid under ebullition. The danger was thought to be over, when a prodigious subterranean noise was heard, resembling the rolling of thunder, but louder and more prolonged than that heard within the tropics during thunder-storms. This noise preceded a perpendicular motion of about three or four seconds, followed by an undulatory motion of somewhat longer duration. The shocks were in opposite directions, from north to south and from east to west. It was impossible that any thing

Successive
shocks.

could resist the motion from beneath upwards, and the undulations crossing each other. The city of Caraccas was completely overthrown. Thousands of the inhabitants (from nine to ten thousand) were buried under the ruins of the churches and houses. The procession had not yet set out; but the crowd in the churches was so great, that nearly three or four thousand individuals were crushed to death by the falling in of the vaulted roofs. The explosion was stronger on the north side of the town, in the part nearest the mountain of Avila and the Silla. The churches of the Trinity and Alta Gracia, which were more than a hundred and fifty feet in height, and of which the nave was supported by pillars from twelve to fifteen feet in diameter, left a mass of ruins nowhere higher than five or six feet. The sinking of the ruins has been so great, that at present hardly any vestige remains of the pillars and columns. The barracks called *El Cuartel de San Carlos*, situated further to the north of the church of the Trinity, on the road to the customhouse de la Pastora, almost entirely disappeared. A regiment of troops of the line, which was assembled in it under arms to join in the procession, was, with the exception of a few individuals, buried under this large building. Nine-tenths of the fine town of Caraccas were entirely reduced to ruins. The houses which did not fall, as those of the street of San Juan, near the Capuchin Hospital, were so cracked that no one could venture to live in them. The effects of the earthquake were not quite so disastrous in the southern and western parts of the town, between the great square and the ravine of Caraguata;—there the cathedral, supported by enormous buttresses, remains standing.

CHAP. XIII.
Overthrow of
Caraccas.

Burial of a
regiment of
troops.

“In estimating the number of persons killed in the city of Caraccas at nine or ten thousand, we do not include those unhappy individuals who were severely wounded, and perished several months after from want of food and proper attention. The night of Holy Thursday presented the most distressing scenes of desolation and sorrow. The thick cloud of dust, which rose

Desolate
scenes.

CHAP. XIII above the ruins and darkened the air like a mist, had fallen again to the ground ; the shocks had ceased ; never was there a finer or quieter night,—the moon, nearly at the full, illuminated the rounded summits of the Silla, and the serenity of the heavens contrasted strongly with the state of the earth, which was strewn with ruins and dead bodies. Mothers were seen carrying in their arms children whom they hoped to recall to life ; desolate females ran through the city in quest of a brother, a husband, or a friend, of whose fate they were ignorant, and whom they supposed to have been separated from them in the crowd. The people pressed along the streets, which now could only be distinguished by heaps of ruins arranged in lines.

Rescue of
the wounded.

Wretched
condition of
the wounded.

“ All the calamities experienced in the great earthquakes of Lisbon, Messina, Lima, and Riobamba, were repeated on the fatal day of the 26th March 1812. The wounded, buried under the ruins, implored the assistance of the passers-by with loud cries, and more than two thousand of them were dug out. Never was pity displayed in a more affecting manner ; never, we may say, was it seen more ingeniously active, than in the efforts made to succour the unhappy persons whose groans reached the ear. There was an entire want of instruments adapted for digging up the ground and clearing away the ruins, and the people were obliged to use their hands for the purpose of disinterring the living. Those who were wounded, as well as the patients who had escaped from the hospitals, were placed on the bank of the little river of Guayra, where they had no other shelter than the foliage of the trees. Beds, linen for dressing their wounds, surgical instruments, medicines, in short every thing necessary for their treatment, had been buried in the ruins. During the first days nothing could be procured,—not even food. Within the city water became equally scarce. The commotion had broken the pipes of the fountains, and the falling in of the earth had obstructed the springs which supplied them. To obtain water it was necessary to descend as

far as the Rio Guayra, which was considerably swollen, CHAP. XIII and there were no vessels for drawing it.

“There remained to be performed towards the dead a Burning the dead. duty imposed alike by piety and the dread of infection. As it was impossible to inter so many thousands or bodies half buried in the ruins, commissioners were appointed to burn them. Funeral-piles were erected among the heaps of rubbish. This ceremony lasted several days. Amid so many public calamities, the people ardently engaged in the religious exercises which Religious exercises. they thought best adapted to appease the anger of Heaven. Some walked in bodies chanting funeral-hymns, while others, in a state of distraction, confessed themselves aloud in the streets. In this city was now repeated what had taken place in the province of Quito after the dreadful earthquake of the 4th February 1797. Marriages were contracted between persons who for many years had neglected to sanction their union by the sacerdotal blessing. Children found parents in persons who Moral effects. had till then disavowed them; restitution was promised by individuals who had never been accused of theft; and families who had long been at enmity drew together from the feeling of a common evil. But while in some this feeling seemed to soften the heart and open it to compassion, it had a contrary effect on others, rendering them more obdurate and inhumane. In great calamities vulgar minds retain still less goodness than strength; for misfortune acts like the pursuit of literature and the investigation of nature, which exercise their happy influence only upon a few, giving more warmth to the feelings, more elevation to the mind, and more benevolence to the character.

“Shocks so violent as these, which in the space of Extent of the earthquake. one minute overthrew the city of Caraccas, could not be confined to a small portion of the continent. Their fatal effects extended to the provinces of Venezuela, Varinas, and Maracaybo, along the coast, and were more especially felt in the mountains of the interior. La Guayra, Mayquetia, Antimana, Baruta, La Vega, San

- CHAP. XIII. Felipe, and Merida, were almost entirely destroyed. The number of dead at La Guayra, and at the villa de San Felipe, near the copper mines of Aroa, exceeded four or five thousand. The earthquake would appear to have been most violent along a line running from E. N. E. to W. S. W., from Guayra and Caraccas towards the high mountains of Niquitao and Merida. It was felt in the kingdom of New Grenada, from the ramifications of the lofty Sierra of Santa Martha to Santa Fe de Bogota, and Honda on the banks of the Magdalena, 620 miles distant from Caraccas. In all parts it was more violent in the cordilleras of gneiss and mica-slate, or immediately at their base, than in the plains. This difference was particularly remarkable in the savannahs of Varinas and Casanare. In the valleys of Aragua, situated between Caraccas and the town of San Felipe, the shocks were very weak. La Victoria, Maracay, and Valencia, scarcely suffered, notwithstanding their proximity to the capital. At Valecillo, not many leagues distant from Valencia, the ground opened, and emitted so great a mass of water that a new torrent was formed. The same phenomenon took place near Porto Cabello. On the other hand, the Lake of Maracaybo underwent considerable diminution. At Coro no commotion was felt, although the town was situated on the coast between other towns which suffered. The fishermen who had passed the day of the 26th March in the island of Orchila, 103 miles N. E. of La Guayra, were not sensible of any shock."
- Towns destroyed.
- Singular phenomena.
- Valley of Capaya.
- Successive commotions.
- Toward the east of Caraccas the commotions were very violent, especially beyond Caurimare, in the valley of Capaya, and as far as the meridian of Cape Codera, while they were very feeble on the coasts of New Barcelona, Cumana, and Paria, though these shores are known to have been formerly shaken by volcanic vapours.
- Fifteen or eighteen hours after the great catastrophe the ground ceased to be agitated; but subsequently to the 27th the tremblings recommenced, and were accompanied with very loud subterranean noises. Frequently

not less than fifteen oscillations were felt in one day. CHAP. XIII.
 On the 5th April there was an earthquake almost as severe as that of the 12th March. The surface was in continuous undulation during several hours, large masses of earth fell in the mountains, and enormous rocks were detached from the Silla. Number of oscillations

While violent agitations were experienced in the valley of the Mississippi, in the island of St Vincent, and in the province of Venezuela, a subterranean noise, resembling an explosion of artillery, was heard at Caraccas, at Calabozo, and on the banks of the Rio Apure, over the space of four thousand square leagues. This sound began at two in the morning of the 30th April, and was as loud on the coast as at the distance of 270 miles. It was every where taken for the firing of guns. Subterranean noise.
 On the same day a great eruption of the volcano of the island of St Vincent took place. This mountain had not ejected lava since 1718, and hardly any smoke was issuing from it, when in May 1811 frequent shocks occurred, and a discharge of ashes, attended with a tremendous bellowing, followed on the 27th April next year. On the 30th the lava overflowed, and after a course of four hours reached the sea. The explosions resembled alternate volleys of very large cannon and musketry. As the space between the volcano of St Vincent and the Rio Apure is 725 miles, these were heard at a distance equal to that between Vesuvius and Paris, and must have been propagated by the earth, and not by the air. Volcanic eruption at St. Vincent.

After adducing numerous instances of the coincidence of volcanic eruptions and earthquakes, Humboldt endeavours to prove that subterranean communications extend to vast distances, that the phenomena of volcanoes and earthquakes are intimately connected, and that the latter have certain lines of direction. Subterranean communications.

CHAPTER XIV.

Journey from Caraccas to the Lake of Valencia.

Departure from Caraccas—La Buenavista—Valleys of San Pedro and the Tuy—Manterola—Zamang-tree—Valleys of Aragua—Lake of Valencia—Diminution of its Waters—Hot Springs—Jaguar—New Valencia—Thermal Waters of La Trinchera—Porto Cabello—Cow-tree—Cocoa-plantations—General View of the Littoral District of Venezuela.

CHAP. XIV. LEAVING the city of Caraccas, on their way to the Orinoco, our travellers slept the first night at the base of the woody mountains which close the valley toward the south-west. They followed the right bank of the Rio Guayra, as far as the village of Antimano, by an excellent road, partly scooped out of the rock. The mountains were all of gneiss or mica-slate. A little before reaching that hamlet they observed two large veins of gneiss in the slate, containing balls of granular diabase or greenstone, composed of felspar and hornblende, with garnet disseminated. In the vicinity all the orchards were full of peach-trees covered with flowers. Between Antimano and Ajuntas they crossed the Rio Guayra seventeen times, and proceeded along the bottom of the valley. The river was bordered by a gramineous plant, the *Gynerium saccharoides*, which sometimes reaches the height of thirty-two feet, while the huts were surrounded by enormous trees of *Laurus persea*, covered by creepers. They passed the night in a sugar-plantation. In a square house were nearly

Departure
from Ca-
raccas.

Orchards.

eighty negroes, lying on skins of oxen spread on the floor, while a dozen fires were burning in the yard, at which people were cooking.

CHAP. XIV.
 Sugar
 plantation.
 Coffee
 plantation.

A great predilection for the culture of the coffee-tree was entertained in the province. The young plants were chiefly procured by exposing the seeds to germination between plantain-leaves. They were then sown, and produced shoots better adapted to bear the heat of the sun than such as spring up in the shade of the plantations. The tree bears flowers only the second year, and its blossoms last only twenty-four hours. The returns of the third year are very abundant; at an average each plant yielding a pound and a half or two pounds of coffee. Humboldt remarks, that although it is not yet a century since the first trees were introduced at Surinam and in the West Indies, the produce of America already amounts to fifteen millions of piastres, or £3,187,500 sterling.

On the 8th of February the travellers set out at sunrise, and after passing the junction of the two small rivers San Pedro and Macarao, which form the Rio Guayra, ascended a steep hill to the table-land of La Buenavista. The country here had a wild appearance, and was thickly wooded. The road, which was so much frequented that long files of mules and oxen met them at every step, was cut out of a talcose gneiss in a state of decomposition. Descending from that point they came upon a ravine, in which a fine spring formed several cascades. Here they found an abundant and diversified vegetation, consisting of arborescent ferns, more than twenty-seven feet high, heliconias, plumerias, browneas, gigantic figs, palms, and other plants. The brownea, which bears four or five hundred purple flowers in a single thyrus, reaches the height of fifty or sixty feet.

Ascent
 to La
 Buenavista.

At the base of the wooded mountain of Higueroa they entered the small village of San Pedro, situated in a basin where several valleys meet. Plantains, potatoes, and coffee, were sedulously cultivated. The rock was

San Pedro.

CHAP. XIV. mica-slate, filled with garnets, and containing beds of serpentine of a fine green, varied with spots of a lighter tint.

Valley of
the Tuy.

Ascending from the low ground, they passed by the farms of Las Lagunetas and Garavatos, near the latter of which there is a mica-slate rock of a singular form,—that of a ridge, or wall, crowned by a tower. The country is mountainous, and almost entirely uninhabited; but beyond this they entered a fertile district, covered with hamlets and small towns. This beautiful region is the valley of the Tuy, where they spent two days at the plantation of Don Jose de Manterola, on the bank of the river, the water of which was as clear as crystal. Here they observed three species of sugar-cane, the old Creole, the Otaheitan, and the Batavian, which are easily distinguished, and of which the most valuable is the Otaheitan, as it not only yields a third more of juice than the Creole cane, but furnishes a much greater quantity of fuel.

Gold mine.

As this valley, like most other parts of the Spanish colonies, has its gold mine, Humboldt was desired to visit it. In the ravine leading to it an enormous tree fixed the attention of the travellers. It had grown on a steep declivity above a house, which it was apprehended it might injure in its fall, should the earth happen to give way. It had therefore been burnt near the root, and cut so as to sink between some large fig-trees, which would prevent it from rolling down. It was eight and a half feet in diameter at the lower end, four feet five inches at the other (the top having been burnt off), and one hundred and sixty feet in length. The rocks were mica-slate passing into talc-slate, and contained masses of bluish granular limestone, together with graphite. At the place where the gold mine was said to have been, they found some vestiges of a vein of quartz; but the subsidence of the earth, in consequence of the rain, rendered it impossible to make any observation. The travellers, however, found a recompense for their fatigues in the harvest of plants which they

Vein of
quartz.

made in the thick forest abounding in cedrælas, brow-
neas, and fig-trees. They were struck by the woody
excrecences, which, as far as twenty feet above the
ground, augment the thickness of the latter. Some of
these trunks were observed to be twenty-three feet in
diameter near the roots.

At the plantation of Tuy the dip of the needle was
41° 6', and the intensity of the magnetic power was
indicated by 228 oscillations in ten minutes. The vari-
ation of the former was 4° 30' N. E. The zodiacal
light appeared almost every night with extraordinary
brilliancy.

On the 11th, at sunrise, they left the plantation of
Manterola, and proceeded along the beautiful banks of
the river. At a farm by the way they found a negress
more than a hundred years old, seated before a small
hut to enjoy the benefit of the sun's rays, the heat of
which, according to her grandson, kept her alive. As
they drew near to Victoria the ground became smoother,
and resembled the bottom of a lake the waters of which
had been drained off. The neighbouring hills were com-
posed of calcareous tufa. Fields of corn were mingled
with crops of sugar-canes, coffee, and plantains. The
level of the country above the sea is only from 576 to
640 yards; and, except in the district of Quatro Villas
in the island of Cuba, wheat is scarcely cultivated in
large quantities in any other part of the equinoctial
regions at so low an elevation. La Victoria and the
neighbouring village of San Matheo yielded 4000 quin-
tals or 3622 cwt. annually. It is sown in December,
and is fit for being cut in seventy or seventy-five days.
The grain is large and white, and the average produce is
three or four times as much as in Europe. The culture
of the sugar-cane, however, is still more productive.

Proceeding slowly on their way, the travellers passed
through the villages of San Matheo, Turmero, and
Maracay, where every thing was indicative of prosperity.
"On leaving the village of Turmero," says Humboldt,

Forest
plants.

Dip of the
needle.

Departure
from Man-
terola.

Varied
cultivation.

Indications
of prosperity

CHAP. XIV. "we discover, at the distance of a league, an object which appears on the horizon like a round hillock, or a tumulus covered with vegetation. It is not a hill, however, nor a group of very close trees, but a single tree, the celebrated *Zamang of Guayra*, known over the whole province for the enormous extent of its branches, which form a hemispherical top 614 feet in circumference. The zamang is a beautiful species of mimosa, whose tortuous branches divide by forking. Its slim and delicate foliage is agreeably detached on the blue of the sky. We rested a long while beneath this vegetable arch. The trunk of the Guayra zamang, which grows on the road from Turmero to Maracay, is not more than 64 feet high and $9\frac{1}{2}$ feet in diameter; but its real beauty consists in the general form of its top. The branches stretch out like the spokes of a great umbrella, and all incline towards the ground, from which they uniformly remain twelve or fifteen feet distant. The circumference of the branches or foliage is so regular, that I found the different diameters 205 and 198 feet. One side of the tree was entirely stripped of leaves from the effect of drought, while on the other both foliage and flowers remained. The branches were covered with creeping plants. The inhabitants of these valleys, and especially the Indians, have a great veneration for the Guayra zamang, which the first conquerors seem to have found nearly in the same state as that in which we now see it. Since it has been attentively observed, no change has been noticed in its size or form. It must be at least as old as the dragon-tree of Orotava. Near Turmero and the Hacienda de Cura there are other trees of the same species, with larger trunks; but their hemispherical tops do not spread so widely."

Effect of drought.

Population.

The valleys of Aragua at this time contained more than 52,000 inhabitants, on a space thirteen leagues in length and two in breadth; making 2000 to a square league, which is almost equal to the densest population of France. The houses were all of masonry, and every

court contained cocoa-trees rising above the habitations. CHAP. XIV.
 Besides wheat, sugar, cacao, cotton, and coffee, indigo is
 cultivated to a great extent.

In this district the travellers experienced the greatest Reception.
 kindness, more especially from the persons with whom
 they had associated in Caraccas, and who possessed large
 estates in these highly improved and beautiful plains.
 At the Hacienda de Cura they spent seven very agree-
 able days, in a small habitation surrounded by thickets,
 on the lake of Valencia. Their host, Count Tovar, had
 begun to let out lands to poor persons, with the view of
 rendering slaves less necessary to the landholders; and
 his example was happily followed by other proprietors.
 Here they lived after the manner of the rich; they
 bathed twice, slept three times, and made three meals
 in twenty-four hours.

The valleys of Aragua form a narrow basin between
 granitic and calcareous mountains of unequal height. Geological
 feature.
 On the north they are separated from the coast by the
 Sierra Mariara, and on the south from the steppes by
 the chain of Guacimo and Yusma. On the east and
 west they are bounded by hills of smaller elevation, the
 rivers from which unite their streams, and are collected
 in an inland lake which has no communication with the
 sea. This body of water, named the lake of Valencia, Lake of
 and by the Indians called Tacarigua, is larger than the
 Lake of Neufchatel, but in its general form has more
 resemblance to that of Geneva. The southern banks are
 desert, and backed by a screen of high mountains, while
 the northern shores are decked with the rich cultiva-
 tion of the sugar-cane, coffee-tree, and cotton. "Paths
 bordered with cestrum, azedarach, and other shrubs
 always in flower, traverse the plain and join the scat-
 tered farms. Every house is surrounded by a tuft of trees.
 The ceiba, with large yellow flowers, gives a peculiar
 character to the landscape, as it unites its branches with
 those of the purple erythrina. The mixture and bril-
 liancy of the vegetable colours form a contrast to the
 unvaried tint of a cloudless sky. In the dry season,

CHAP. XIV. when the burning soil is covered with a wavy vapour, artificial irrigations keep up its verdure and fecundity. Here and there the granitic rocks pierce the cultivated land, and enormous masses rise abruptly in the midst of the plain, their base and fissured surfaces affording nourishment to some succulent plants, which prepare a soil for future ages. Often on the summit of these detached hills, a fig-tree or a clusia, with juicy leaves, have fixed their roots in the rock, and overlook the landscape. With their dead and withered branches they seem like signals erected on a steep hill. The form of these eminences reveals the secret of their origin; for when the whole of this valley was filled with water, and the waves beat against the base of the peaks of Mariara, the Devil's Wall, and the coast chain, these rocky hills were shoals or islets."

Lake of
Valencia.

But the Lake of Valencia is remarkable for other circumstances than its beauties. From a careful examination, Humboldt was convinced that, in very remote times, the whole valley, from the mountains of Cocuyza to those of Torito and Nirgua, and from the Sierra of Mariara to that of Guigue, Guacimo, and La Palma, had been filled with water. The form of the promontories and their abrupt slopes indicate the shores of an Alpine lake. The same little shells (*helicites* and *valvatæ*), which occur at the present day in the Lake of Valencia, are found in layers three or four feet thick in the heart of the country, as far as Turmero and La Concesion near Victoria. These facts prove a retreat of the waters; but no evidence exists that any considerable diminution of them has taken place in recent times, although within the thirty years preceding Humboldt's visit the gradual desiccation of this great basin had excited general attention. This, however, is not dependent upon subterranean channels, as some suppose, but upon the effects of evaporation, increased by the changes operated upon the surface of the country. Forests, by sheltering the soil from the direct action of the sun, diminish the waste of moisture; consequently, when

Diminution
of water.

they are imprudently destroyed, the springs become less abundant, or are entirely dried up. Till the middle of the last century, the mountains that surround the valleys of Aragua were covered with woods, and the plains with thickets interspersed with large trees. As cultivation increased, the sylvan vegetation suffered; and as the evaporation in this district is excessively powerful, the little rivers were dried up in the lower portion of their course during a great part of the year. The land that surrounds the lake being quite flat and even, the decrease of a few inches in the level of the water exposed a vast extent of ground, and as it retired the planters took possession of the new land.

CHAP. XIV.

Destruction
of woods.

The idea that the lake will soon entirely disappear, Humboldt treats as chimerical, considering it probable that a period will shortly arrive when the supply of water by the rivers and the evaporation will balance each other. The mean depth is from 77 to 96 feet, and there are some parts not less than 224 or 256 feet. The length is thirty-four and a half miles, and the breadth four or five. The temperature at the surface, in February, was from 73·4° to 74·7°, which was a little lower than the mean temperature of the air.

Balance of
influences.

The Lake of Valencia is covered with beautiful islands to the number of fifteen, some of which are cultivated. It is well stocked with fish, although it furnishes only three kinds, which are soft and insipid. A small crocodile, the bava, which generally attains the length of three or four feet, is very common; but it is remarkable that neither the lake nor any of the rivers which flow into it have any large alligators, though these animals abound, a few leagues off, in the streams that unite with the Apure and Orinoco, or pass directly into the Caribbean Sea. The islands are of gneiss, like the surrounding country. Of the plants which they produce, many have been believed to be peculiar to the district, such as the papaws of the lake, and the tomatoes of the island of Cura. The aquatic vegetation along the shores reminded the travellers of the lakes of Europe, although

Islands on
the lake.Peculiar
plants.

CHAP. XIV. the species of potamogeton, chara, and equisetum, were peculiar to the New Continent.

Rivers.

Some of the rivers that flow into this fine sheet of water owe their origin to hot springs, of which, however, the travellers were able to examine only those of Mariara and Las Trincheras. In going up the Cura toward its source, the mountains of Mariara are seen advancing into the plain, in the form of an amphitheatre composed of steep rocks, crowned by serrated peaks. The central point is named Rincon del Diablo. These

Rincon del
diablo.

masses are composed of a coarse-grained granite, and are partially covered with vegetation. In the hills toward the east of the Rincon is a ravine containing several small basins, the two uppermost of which are only eight inches in diameter, while the three lower are from two to three feet. Their depth varies from three to fifteen inches, and their temperature is from 133° to 138°.

Hot springs.

The hot water from these funnels forms a rill, which thirty feet lower has a temperature of only 118·4°. These springs are slightly impregnated with sulphuretted hydrogen gas, the fluid having a thin pellicle of sulphur; while a few plants in the vicinity are crusted with the same substance. To the south of this ravine, in the plain extending to the shores of the lake, is another fountain of the same kind, which issues from a crevice. The water, which is not so hot, collects in a basin fifteen or eighteen feet in diameter and three feet deep, in which the slaves of the neighbouring plantations wash at the end of the day. Here the travellers also bathed, and afterwards found in the surrounding woods a great variety of beautiful plants.

Bathing.

While drying themselves in the sun, after coming out of the pool, a little mulatto approached them, bowing gravely, and making a long speech on the virtues of the water. Showing them his hut, he assured them they should find in it all the conveniences of life; but his attentions ceased the moment he heard they had come merely to satisfy their curiosity, and had no intention to try the efficacy of the baths. They are said to be

used with success in rheumatic swellings, old ulcers, and the dreadful affections of the skin called bubas. CHAP. XIV.

On the 21st February the travellers set out from the Hacienda de Cura for Guacara and New Valencia. As the heat was excessive, they preferred travelling by night. Near the hamlet of Punta Zamuro, at the foot of the lofty mountains of Las Viruelas, the road was bordered by large mimosas sixty feet in height, and with horizontal branches meeting at a distance of more than fifty yards, so as to form a most beautiful canopy of verdure. The night was gloomy, and the Rincon del Diablo with its serrated cliffs appeared from time to time illuminated by the burning of the savannahs. At a place where the wood was thickest their horses were frightened by the yelling of a large jaguar, which seemed to follow them closely, and which they were informed had roamed among these mountains for three years, having escaped the pursuit of the most intrepid hunters. Night travelling.

They spent the 22d in the house of the Marquis de Toro, at the village of Guacara, a large Indian community; and in the evening, after visiting Mocundo, an extensive sugar-plantation near it, they continued their journey to New Valencia. They passed a little wood of palms of the genus *Corypha*, the withered foliage of which, together with the camels feeding in the plain, and the undulating motion of the vapours on the arid soil, gave the landscape quite an African character. The sterility of the land increased as they advanced towards the city, which is said to have been founded in 1555 by Alonzo Diaz Moreno, and contains a population of six or seven thousand individuals. The streets are broad; and as the houses are low, they occupied a large extent of ground. Here the termites or white ants were so numerous that their excavations resembled subterranean canals, which, being filled with water in rainy weather, became extremely dangerous to the buildings. House of the Marquis de Toro.
Sterility of the land.

On the 26th they set out for the farm of Barbula, to examine a new road that was making from the city to New road.

CHAP. XIV. Porto Cabello ; and on the 27th visited the hot springs of La Trinchera, ten miles from Valencia. These fountains were so copious as to form a rivulet, which, during the greatest droughts, was two feet deep and eighteen wide. The temperature of the water was 194.5°. Eggs immersed in them were boiled in less than four minutes. They issued from granite, and were strongly impregnated with sulphuretted hydrogen. A sediment of carbonate of lime was deposited, and the most luxuriant vegetation surrounded the basin,—mimosas, clusias, and fig-trees, pushing their roots into the water, and extending their branches over it. Forty feet distant from these remarkable sources there rose others which were of the ordinary temperature. Humboldt remarks, that in all climates people show the same predilection for heat. In Iceland the first Christian converts would be baptized only in the tepid streams of Hecla ; and in the torrid zone, the natives flock from all parts to the thermal waters. The river which is formed by the fountains of La Trinchera runs toward the north-east, and near the coast expands to a considerable size.

Hot springs.

Predilection
for heat.

Porto
Cabello.

M. Juliac.

Descending toward Porto Cabello, the travellers passed through a very picturesque district, beautified by a most luxuriant vegetation and numerous cascades. A stratified coarse-grained granite occurred near the road. The heat became suffocating as they approached the coast, and a reddish vapour veiled the horizon. In the evening they reached the town, where they were kindly received by a French physician, M. Juliac, whose house contained an interesting collection of zoological subjects. This gentleman was principal surgeon to the royal hospital, and was celebrated for his profound acquaintance with the yellow fever. He stated, that when he had treated his patients by bleeding, aperients, and acid drinks, in hospitals where the sick were crowded, the mortality was 33 in 100 among the white Creoles, and 65 in 100 among recently-disembarked Europeans ; but that since a stimulating treatment, and

the use of opium, benzoin, and alcoholic draughts had been substituted for the old debilitating method, the mortality had been reduced to 20 in 100 among Europeans, and 10 among natives. CHAP. XIV.

The heat of Porto Cabello is not so intense as that of La Guayra, the breeze being stronger and more regular, and the air having more room to circulate between the coast and the mountains. The cause of the insalubrity of the atmosphere is therefore to be sought for in the exhalations that arise from the shore to the eastward, where at the beginning of the rainy season tertian fevers prevail, which easily degenerate into the continued typhoid. It has been observed that the mestizoes employed in the salt-works have a yellower skin when they have suffered several successive years from these fevers. The fishermen assert, that the unwholesomeness of the air is owing to the overflowings of the rivers, and not to inundations of the sea ; and it has been found that the extended cultivation along the banks of the Rio Estevan has rendered them less pestilential.

The salt-works are similar to those of Araya, near Cumana ; but the earth at Porto Cabello contains less muriate of soda. As the employment is very unhealthy, the poorest persons alone engage in it. The defence of the coasts of Terra Firma was maintained at six points, the castle of San Antonio at Cumana, the Morro de Nueva Barcelona, the fortifications of La Guayra, Porto Cabello, Fort St Charles, and Carthagena. Next to Carthagena the most important place is Porto Cabello. The harbour is one of the finest in the world, resembling a basin or little inland lake, opening to the westward by a passage so narrow that only one vessel can anchor at a time, and is defended by batteries. The upper part of it is marshy ground filled with stagnant and putrid water. At the time of Humboldt's visit the number of inhabitants was 9000.

Leaving Porto Cabello on the 1st March at sunrise, our travellers were astonished at the number of boats which they saw laden with fruit for the market. They

CHAP. XIV. returned to the valleys of Aragua, and again stopped at the farm of Barbula. Having heard of a tree the juice of which resembles milk and is used as an article of food, they visited it, and to their surprise found that the statements which had been made to them with respect to it were correct. It is named the *palo de vaca* or *cow-tree*, and has oblong pointed leaves, with a somewhat fleshy fruit containing one or sometimes two nuts. When an incision is made in the trunk, there issues abundantly a thick glutinous milky fluid, perfectly free from acrimony, and having an agreeable smell. It is drunk by the negroes and free people who work in the plantations, and the travellers took a considerable quantity of it without the least injurious effect. When exposed to the air, this juice presents on its surface a yellowish cheesy substance, in membranous layers, which are elastic, and in five or six days become sour, and afterwards putrefy.

Use of its
juice.

The cow-tree appears to be peculiar to the littoral cordillera, and occurs most plentifully between Barbula and the Lake of Maracaybo.

Observations
of Humboldt

“Among the many curious phenomena,” says Humboldt, “which presented themselves to me in the course of my travels, I confess there were few by which my imagination was so powerfully affected as the cow-tree. All that relates to milk and to the cereal plants inspires us with an interest, which is not merely that of the physical knowledge of things, but which connects itself with another order of ideas and feelings. We can hardly imagine how the human species could exist without farinaceous substances, and without the nutritious fluid which the breast of the mother contains, and which is appropriated to the condition of the feeble infant. The amylaceous matter of the cereal plants—the object of religious veneration among so many ancient and modern nations—is distributed in the seeds, and deposited in the roots of vegetables; while the milk which we use as food appears exclusively the product of animal organization. Such are the impressions which we receive in

early childhood, and such is the source of the astonishment with which we are seized on first seeing the cow-tree. Magnificent forests, majestic rivers, and lofty mountains clad in perennial snows, are not the objects which we here admire. A few drops of a vegetable fluid impress us with an idea of the power and fecundity of nature. On the parched side of a rock grows a tree with dry and leathery foliage, its large woody roots scarcely penetrating into the ground. For several months in the year its leaves are not moistened by a shower; its branches look as if they were dead and withered; but when the trunk is bored, a bland and nourishing milk flows from it. It is at sunrise that the vegetable fountain flows most freely. At that time the blacks and natives are seen coming from all parts, provided with large bowls to receive the milk, which grows yellow and thickens at its surface. Some empty their vessels on the spot, while others carry them to their children. One imagines he sees the family of a shepherd who is distributing the milk of his flock."

CHAP. XIV.
Surprise
excited by
the cow-
tree.

The travellers had resolved to visit the eastern extremity of the cordilleras of New Grenada, where they end in the Paramos of Tirnotes and Niquitas; but learning at Barbula that this excursion would retard their arrival at the Orinoco thirty-five days, they judged it prudent to relinquish it, lest they should fail in the real object of their journey,—that of ascertaining by astronomical observations the point at which the Rio Negro and the River of Amazons communicate with the former stream. They therefore returned to Guacara, to take leave of the family of the Marquis del Toro, and pass three days more on the shores of the Lake of Valencia. It happened to be the time of carnival, and all was gayety. The games in which the common people indulged were occasionally not of the most pleasant kind. Some led about an ass laden with water, with which they sprinkled the apartments wherever they found an open window; while others, carrying bags full of the hairs of the

Change of
plans.

Return to
Guacara.

CHAP. XIV. *Dolichos pruriens*, which excite great irritation of the skin, blew them into the faces of those who were passing by. From Guacara they returned to New Valencia, where they found a few French emigrants, the only ones they saw during five years in the Spanish colonies.

Carnival

Cacao-plan-
tations

The cacao-plantations have always been considered as the principal source of the prosperity of these countries. The tree (*Theobroma cacao*) which produces this substance is not now found wild in the woods to the north of the Orinoco, and begins to be seen only beyond the cataracts of Atures and Maypures ; but it abounds near the Ventuaro, and on the Upper Orinoco. In the plantations it vegetates so vigorously, that flowers spring out even from the woody roots wherever they are left uncovered. It suffers from the north-east winds ; and the heavy showers that fall during the winter season, from December to March, are very injurious to it. Great humidity is favourable only when it augments gradually and continues a long time without interruption. In the dry season, when the leaves and young fruit are wetted by a heavy shower, the latter falls to the ground. For these reasons the cacao harvest is very uncertain, and the causes of failure are increased by the depredations of worms, insects, birds, and quadrupeds. This branch of agriculture has the disadvantage, moreover, of obliging the new planter to wait eight or ten years for the fruit of his labours, and of yielding an article of very difficult preservation ; but it requires a much less number of slaves than most others, one being sufficient for a thousand trees, which at an average yield twelve fanegas annually. It appeared probable, that from 1800 to 1806 the yearly produce of the cacao-plantations of the capitania-general of Caraccas was at least 193,000 fanegas, or 287,290 bushels, of which the province of Caraccas furnished three-fourths. The crops are gathered twice a-year, at the end of June and of December.

Uncer-
tainty of
the cacao
harvest.

Humboldt states, as the result of numerous local estimates, that Europe consumes,—

23,000,000 pounds of cacao, at 120 fr. per 100 lbs. =	27,600,000fr.	CHAP. XIV.
32,000,000 pounds of tea, at 4 fr. per lb.	= 128,000,000	—
140,000,000 pounds of coffee, at 114 fr. per 100 lbs. =	159,600,000	Consumption
450,000,000 pounds of sugar, at 54 fr. per 100 lbs. =	243,000,000	of cacao.
Total value, £23,250,000 sterling, or 558,200,000fr.		

The late wars have had a very injurious effect on the cacao-trade of Caraccas; and the cultivation of this article seems to be gradually declining. It is asserted that the new plantations are not so productive as the old, the trees not acquiring the same vigour, and the harvest being later and less abundant. This is supposed to be owing to exhaustion of the land; but Humboldt attributes it rather to the diminution of moisture caused by cropping.*

In concluding his remarks on the province of Venezuela, our author gives a general view of the soil and metallic productions of the districts of Aroa, Barquesimeto, and Carora. From the Sierra Nevada of Merida, and the Paramos of Niquitao, Bocono, and Las Rosas, the eastern cordillera of New Grenada decreases so rapidly in height, that between the ninth and tenth degrees of latitude it forms only a chain of hills, which separate the rivers that join the Apure and the Orinoco from those that flow into the Caribbean Sea or the Lake of Maracaybo. On this ridge are built the towns of Nirgua, San Felipe, Barquesimeto, and Tocuyo. The ground rises toward the south.

Soil of metallic productions.

In the cordillera just described, the strata usually dip to the N.W.; so that the waters flow in that direction over the ledges, forming those numerous torrents and rivers, the inundations caused by which are so fatal to

Dip of strata.

* According to Macculloch, the little use made of this excellent beverage in England may be ascribed to the oppressiveness of the duties with which it has been loaded, and not to its being unsuitable to the public taste. "In 1832 the duties on cacao from a British plantation were reduced from 56s. to 18s. 8d. a-cwt. Foreign cacao is still subject to the oppressive duty of 56s. a-cwt. British cacao is worth, at present (August 1833), from 64s. to 74s. a-cwt. in bond."—*Macculloch's Dictionary of Commerce, art. Cacao* (2d Edition).

CHAP. XIV. the health of the inhabitants from Cape Codera to the
Lake of Maracaybo.

Streams.

Of the streams that descend N.E. towards the coast of Porto Cabello and La Puente de Hicacos, the most remarkable are the Tocuyo, Aroa, and Yaracuy; the valleys of which, were it not for morbid miasmata, would perhaps be more populous than those of Aragua, as the soil is prolific and the waters navigable. In a lateral valley, opening into that of the Aroa, are copper-mines; and in the ravines nearer the sea are similar ores and gold-washings. The total produce of both amounts to a quantity varying from 1087 to 1368 cwts. of excellent metal. Indications of silver and gold have been found in various parts.

Savannans

The Savannahs or Llanos of Monai and Carora, separated from the great plains of Portuguesa and Calabozo by the mountainous tract of Tocuyo and Miguá, although bare and arid, are oppressed with miasmata; and Humboldt seems to think that their insalubrity may be owing to the disengagement of sulphuretted hydrogen gas.

CHAPTER XV.

Journey across the Llanos from Aragua to San Fernando.

Mountains between the Valleys of Aragua and the Llanos—Their Geological Constitution—The Llanos of Caraccas—Route over the Savannah to the Rio Apure—Cattle and Deer—Vegetation—Calabozo—Gymnoti or Electric Eels—Indian Girl—Alligators and Boas—Arrival at San Fernando de Apure.

FROM the chain of mountains which borders the Lake of Valencia toward the south, there stretches in the same direction a vast extent of level land, constituting the Llanos or Savannahs of Caraccas; and from the cultivated and populous district of Aragua, embellished with mountains and rivers, and teeming with vegetation, one descends into a parched desolate plain, bounded by the horizon. On this route we now accompany our travellers, who on the 6th March left the valleys of Aragua, and keeping along the south-west side of the lake, passed over a rich champaign country covered with calabashes, water-melons, and plantains. The rising of the sun was announced by the howling of monkeys, of which they saw numerous bands moving as in procession from one tree to another. These creatures (the *Simia ursina*) execute their evolutions with singular uniformity. When the boughs of two trees do not touch each other, the leader of the party swings himself by the tail upon the nearest twigs, the rest following in regular succession. The distance to which their howlings may be heard was ascertained by Humboldt to be 1705 yards. The Indians assert that one always chants as leader of the choir; and the missionaries say that when

CHAP. XV.
Savannahs of
Caraccas.

Sunrise.

CHAP. XV. a female is on the point of bringing forth, the howlings are suspended till the moment when the young appear.

Village of
Guilgue.

The travellers passed the night at the village of Guilgue near the lake, where they lodged with an old sergeant, a native of Murcia, who amused them with a recital of the history of the world in Latin, which he had learned among the Jesuits. Leaving this place, they began to ascend the chain of mountains which extends towards La Palma, and from the top of an elevated platform took their last view of the valleys of Aragua. The rock was gneiss with auriferous veins of quartz. Arriving at the hamlet of Maria Magdalena, they were stopped by the inhabitants, who wanted to force their muleteers to hear mass. Seven miles farther on they came to the Villa de Cura, situated in an arid valley almost destitute of vegetation. Here they remained for the night, and joined an assembly of nearly all the residents in the town, to admire in a magic-lantern a view of the great capitals of Europe. This place, which contains a population of four thousand, is celebrated for the miracles performed by an image of the Virgin found by an Indian in a ravine.

Village of
San Juan.

Continuing to descend the southern declivity of the range, they passed part of the night of the 11th at the village of San Juan, remarkable for its hot springs and the singular form of two mountains in the neighbourhood, called the Morros, which rise like slender peaks from a wall of rocks. At two in the morning they continued their journey by Ortiz and Parapara to the Mesa de Paja. The ground over which they travelled forms the ancient shore of the Llanos; and, as the chain has now been traversed, it may be interesting to present a brief view of its geological constitution.

Geological
features.

In the Sierra de Mariara, near Caraccas, the rock is coarse-grained granite. The valleys of Aragua, the shores of the Lake of Valencia, its islands, and the southern branch of the coast-chain, are of gneiss and mica-slate, which are auriferous. At San Juan some of the rocks were gneiss passing into mica-slate. On the

south of this place the gneiss is concealed beneath a deposit of serpentine, which, farther south, passes into or alternates with greenstone. This rock is now the principal one, and in the midst of it rise the Morros of San Juan, composed of crystalline limestone of a greenish-gray colour, and containing masses of dark-blue indurated clay. Behind the Morros is another compact limestone containing shells. The valley that descends from San Juan to the Llanos is filled with trap-rocks lying upon green-slate. Lower down the rocks take a basaltic aspect. Farther south the slates disappear, being concealed under a trap-deposit of varied appearance, but assuming an amygdaloidal character, and on the margin of the plain is seen a formation of clinkstone or porphyry-slate.

CHAP. XV.
Greenstone.

The travellers now entered the basin of the Llanos. The sun was almost in the zenith, the ground was at the temperature of 118° or 122°, and the suffocating heat was augmented by the whirls of dust which incessantly arose from the surface of the steril soil. All around, the plains seemed to ascend into the sky. The horizon in some parts was clear and distinct, while in others it seemed undulating or blended with the atmosphere. The trunks of palm-trees, stripped of their foliage, and seen from afar through the haze, resembled the masts of ships discovered on the verge of the ocean.

Basin of the Llanos.

In order to give some interest to the narrative of a journey across a tract of so monotonous an aspect, Humboldt presents a general view of the plains of America, contrasted with the deserts of Africa and the fertile steppes of Asia, of which, however, the most striking points alone can be here taken. There is something awful and melancholy, he says, in the uniform aspect of these savannahs, where every thing seems motionless, and where the shadow of a cloud hardly ever falls for months. He even doubts whether the first sight of the Andes or of the Llanos excites most astonishment; for, as mountainous countries have a similarity of appearance, whatever may be the elevation

American plains.

CHAP. XV. of their summits, the view of a very elevated range is perhaps not so striking as that of a boundless plain, spread out like an ocean, and on all sides mixing with the sky.

Plains of
different
continents.

It has been said that Europe has its *heaths*, Asia its *steppes*, Africa its *deserts*, and America its *savannahs*; and these great divisions of the globe have been characterized by these circumstances. But as the term heath always supposes the existence of plants of that name, and as all the plains of Europe are not heathy, the description is incorrect. Nor are the steppes of Asia always covered with saline plants, some of them being real deserts; neither are the American Llanos always grassy. Instead of designating the vast levels of these different regions by the nature of the plants which they produce, it seems proper to distinguish them into *deserts*, and *steppes* or *savannahs*, by which terms would be meant plains destitute of vegetation, or covered with grasses or small dicotyledonous plants. The savannahs of North America have been designated by the name of *prairies* or meadows; but the phrase is not very applicable to pastures which are often dry. The Llanos and Pampas of South America are real steppes, displaying a beautiful verdure in the rainy season, but during great droughts assuming the aspect of a desert. The grass is then reduced to powder, the ground cracks, and the alligators and serpents bury themselves in the mud, where they remain in a state of lethargy till they are roused by the showers of spring. On the borders of rivulets, however, and around the little pools of stagnant water, thickets of the *Mauritia* palm preserve a brilliant verdure, even during the driest part of the year.

Prairie.

Want of hills.

The principal characteristic of the savannahs of South America is the entire want of hills. In a space extending to 360 square miles, there is not a single eminence a foot high. These plains, however, present two kinds of inequalities: the *bancos*, consisting of broken strata of sandstone or limestone, which stand four or five feet above the surface; and the *mesas*, composed of small

flats or convex mounds, rising gradually to the height of a few yards. The uniform aspect of these flats, the extreme rarity of inhabitants, the fatigue of travelling under a burning sky amid clouds of dust, the continual recession of the horizon, and the successive appearance of solitary palms, make the steppes appear far more extensive than they really are. It has even been imagined that the whole eastern side of South America, from the Orinoco and the Apure to the Plata and the Straits of Magellan, is one great level; but this is not the case. In order to understand their limitations it will be necessary to take a general view of the mountain-ranges.

CHAP. XV.

Uniform aspect of the flats.

The cordillera of the coast, where the highest summit is the Silla of Caraccas, and which is connected by the Paramo de las Rosas to the Nevado de Merida, and the Andes of New Grenada, has already been described. A less elevated but much larger group of mountains extends from the mouths of the Guaviare and the Meta, the source of the Orinoco, the Marony, and the Essequibo, toward French and Dutch Guiana. This, which is named the cordillera of Parime, may be followed for a length of 863 miles, and is separated from the Andes of New Grenada by a space 276 miles in breadth. A third chain of mountains, which connects the Andes of Peru with the mountains of Brazil, is the cordillera of Chiquitos, dividing the rivers flowing into the Amazon from the tributaries of the Plata.

Cordillera.

These three transverse chains or groups, extending from west to east within the limits of the torrid zone, are separated by level tracts forming the plains of Caraccas or of the Lower Orinoco, the flats of the Amazon and Rio Negro, and those of Buenos Ayres or La Plata. The middle basin, known by the colonists under the name of the *bosques* or *selvas* of the Amazon, is covered with trees; the southern, the *pampas* of Buenos Ayres, with grass; and the northern, the *llanos* of Varinas and Caraccas, with plants of various kinds.

Transverse chains of mountains.

The western coasts of South America are bordered by

CHAP. XV. **a wall of mountains, pierced at intervals by volcanic fires, and constituting the celebrated cordillera of the Andes, the mean height of which is 11,830 feet. It extends in the direction of a meridian, sending out two lateral branches, one in lat. 10° north, being that of the coast of Caraccas, the other in lat. 16° and 18° south, forming the cordillera of Chiquitos, and widening eastward in Brazil into vast table-lands. Between these lines is a group of granitic mountains, running from 3° to 7° north latitude, in a direction parallel to the equator, but not united to the Andes. These three chains have no active volcanoes, and none of their summits enter the line of perpetual snow. They are separated by plains, which are closed toward the west and open toward the east; and they are so low, that were the Atlantic to rise 320 feet at the mouth of the Orinoco and 1280 feet at the mouth of the Amazon, more than the half of South America would be covered, and the eastern declivity of the Andes would become a shore of the ocean.**

El Cayman.

We now accompany the travellers on their route from the northern side of the Llanos to the banks of the Apure, in the province of Varinas. After passing two nights on horseback, they arrived at a little farm called El Cayman, where was a house surrounded by some small huts covered with reeds and skins. They found an old negro who had the management of the farm during his master's absence. Although he told them of herds composed of several thousand cows, they asked in vain for milk, and were obliged to content themselves with some muddy and fetid water drawn from a neighbouring pool, of which they contrived to drink by using a linen cloth as a filter. When the mules were unloaded, they were set at liberty to go and search for water, and the strangers following them came upon a copious reservoir surrounded with palm-trees. Covered with dust, and scorched by the sandy wind of the desert, they plunged into the pool, but had scarcely begun to enjoy its coolness when the noise of an alligator floundering in

Want of
w. ter.

the mud induced them to make a precipitate retreat. CHAP. XV.
 Night coming on, they wandered about in search of the farm, but did not succeed in finding it, and at length re-^{Night} solved to seat themselves under a palm-tree, in a dry adventure.
 spot surrounded by short grass, when an Indian, who had been on his round collecting the cattle, coming up on horseback, was persuaded, though not without difficulty, to guide them to the house. At two in the morning they set off, with the view of reaching Calabozo before noon. The aspect of the country continued the same. There was no moonlight, but the great masses of nebulæ illumined part of the terrestrial horizon as they set out. As the sun ascended, the phenomena of mirage presented themselves in all their modifications. ^{Mirage.}
 The little currents of air that passed along the ground had so variable a temperature, that in a herd of wild cows some appeared with their legs raised from the surface, while others rested upon it. The objects were generally suspended, but no inversion was observed. At sunrise the plains assumed a more animated appearance; the horses, mules, and oxen, which graze on them in a state of freedom, after having reposed during the night beneath the palms, now assembled in crowds. As the travellers approached Calabozo, they saw troops of small deer feeding in the midst of the cattle. These animals, which are called *matacani*, are a little larger than the ^{Matacani.} roe of Europe, and have a sleek fawn-coloured pile, spotted with white. Some of them were entirely of the latter hue. Their flesh is good; and their number is so great that a trade in their skins might be carried on with advantage, but the inhabitants are too indolent to engage in any active occupation.

These steppes were principally covered with grasses of ^{Grasses.} the genera *hillingia*, *cenchrus*, and *paspalum*, which at that season scarcely attain a height of nine or ten inches near Calabozo and St Jerome del Pirital, although on the banks of the Apure and Portuguesa they rise to the length of four feet. Along with these were mingled some *turneræ*, *malvaceæ*, and *mimosæ*. The pastures

CHAP. XV. are richest on the banks of the rivers, and under the shade of corypha palms. These trees were singularly uniform in size ; their height being from twenty-one to twenty-five feet, and their diameter from eight to ten inches. The wood is very hard, and the fan-like leaves are used for roofing the huts scattered over the plains. A few clumps of a species of rhopala occur here and there.

Excessive
heat.

The philosophers suffered greatly from the heat in crossing the Mesa de Calabozo. Whenever the wind blew, the temperature rose to 104° or 106°, and the air was loaded with dust. The guides advised them to fill their hats with the rhopala leaves, to prevent the action of the solar rays on the head, and from this expedient they derived considerable benefit.

Calabozo.

At Calabozo they experienced the most cordial hospitality from the administrator of the Real Hacienda, Don Miguel Cousin. The town, which is situated between the Guarico and the Urituco, has a population of 5000. The principal wealth of the inhabitants consists of cattle, of which it was computed that there were 98,000 in the neighbouring pastures. M. Depons estimates the number in the plains, extending from the mouths of the Orinoco to the Lake of Maracaybo, at 1,200,000 oxen, 180,000 horses, and 90,000 mules ; and in the Pampas of Buenos Ayres, it is believed that there are 12,000,000 of cows and 3,000,000 of horses, not including cattle which have no acknowledged owner. In the Llanos of Caraccas, the richer proprietors of the great hatos, or cattle-farms, brand 14,000 head every year, and sell 5000 or 6000. The exportation from the whole capitania-general amounts annually to 174,000 skins of oxen and 11,500 of goats, for the West India Islands alone. This stock was first introduced about 1548 by Christoval Rodriguez. They are of the Spanish breed, and their disposition is so gentle that a traveller runs no risk of being attacked or pursued by them. The horses are also descended from ancestors of the same country, and are generally of a brown colour. There were no sheep in the plains.

Number of
cattle.

Humboldt remarks, that when we hear of the prodigious numbers of oxen, horses, and mules, spread over the plains of America, we forget that in civilized Europe the aggregate amount is not less surprising. According to M. Peuchet, France feeds 6,000,000 of the large horned class; and in the Austrian monarchy, the oxen, cows, and calves, are estimated by Mr Lichtenstein at about 13,400,000.

CHAP. XV.

European
cattle.

At Calabozo, in the midst of the Llanos, the travellers found an electrical apparatus nearly as complete as those of Europe, made by a person who had never seen any such instrument, had received no instructions, and was acquainted with the phenomena of electricity only by reading the treatise of Sigaud de la Fond, and Franklin's Memoirs. Next to this piece of mechanism, the objects that excited the greatest interest were the electrical eels, or gymnoti, which abound in the basins of stagnant water and the confluents of the Orinoco. The dread of the shocks given by these animals is so great among the common people and Indians, that for some time no specimens could be procured, and one which was at length brought to them afforded very unsatisfactory results.

Electric
apparatus.Electrical
eels.

On the 19th March, at an early hour, they set off for the village of Rastro de Abaxo, whence they were conducted by the natives to a stream, which in the dry season forms a pool of muddy water surrounded by trees. It being very difficult to catch the gymnoti with nets, on account of their extreme agility, it was resolved to procure some by intoxicating or benumbing them with the roots of certain plants, which when thrown into the water produce that effect. At this juncture the Indians informed them that they would fish with horses, and soon brought from the savannah about thirty of these animals, which they drove into the pool.

Catching
gymnoti.

"The extraordinary noise caused by the horses' hoofs makes the fishes issue from the mud, and excites them to combat. These yellowish and livid eels resembling large aquatic snakes, swim at the surface of the water, and crowd under the bellies of the horses and mules.

Fishing with
horses.

CHAP. XV. The struggle between animals of so different an organization affords a very interesting sight. The Indians, furnished with harpoons and long slender reeds, closely surround the pool. Some of them climb the trees, whose branches stretch horizontally over the water. By their wild cries and their long reeds, they prevent the horses from coming to the edge of the basin. The eels, stunned by the noise, defend themselves by repeated discharges of their electrical batteries, and for a long time seem likely to obtain the victory. Several horses sink under the violence of the invisible blows which they receive in the organs most essential to life, and, benumbed by the force and frequency of the shocks, disappear beneath the surface. Others, panting, with erect mane, and haggard eyes expressive of anguish, raise themselves and endeavour to escape from the storm which overtakes them, but are driven back by the Indians. A few, however, succeed in eluding the active vigilance of the fishers; they gain the shore, stumble at every step, and stretch themselves out on the sand, exhausted with fatigue, and having their limbs numbed by the electric shocks of the gymnoti.

Indian
fishers

Destruction
of the horses.

Electric
discharge of
the eel.

“In less than five minutes two horses were killed. The eel, which is five feet long, presses itself against the belly of the horse, and makes a discharge along the whole extent of its electric organ. It attacks at once the heart, the viscera, and the cæliac plexus of the abdominal nerves. It is natural that the effect which a horse experiences should be more powerful than that produced by the same fish on man, when he touches it only by one of the extremities. The horses are probably not killed but only stunned; they are drowned from the impossibility of rising amid the prolonged struggle between the other horses and eels.”

Capture of
the gymnoti

The gymnoti at length dispersed, and approached the edge of the pool, when five of them were taken by means of small harpoons fastened to long cords. A few more were caught towards evening, and there was thus obtained a sufficient number of specimens on which to

make experiments. The results of Humboldt's observations on these animals may be stated briefly as follows :—

CHAP. XV.

Experiments
on the
gymnotus.

The gymnotus is the largest electrical fish known, some of those measured by him being from 5 feet 4 inches to 5 feet 7 inches in length. One, 4 feet 1 inch long, weighed $15\frac{3}{4}$ Troy pounds, and its transverse diameter was 3 inches $7\frac{1}{2}$ lines. The colour was a fine olive-green; the under part of the head yellow mingled with red. Along the back are two rows of small yellow spots, each of which contains an excretory aperture for the mucus, with which the skin is constantly covered. The swimming-bladder is of large size, and before it is situated another of smaller dimensions; the former separated from the skin by a mass of fat, and resting upon the electric organs, which occupy more than two-thirds of the fish.

It would be rash to expose one's self to the first shocks of a very large individual,—the pain and numbness which follow in such a case being extremely violent. When in a state of great weakness, the animal produces in the person who touches it a twitching, which is propagated from the hand to the elbow; a kind of internal vibration lasting two or three seconds, and followed by painful torpidity, being felt after every stroke. The electric energy depends upon the will of the creature, and it directs it toward the point where it feels most strongly irritated. The organ acts only under the immediate influence of the brain and heart; for, when one of them was cut through the middle, the fore part of the body alone gave shocks. Its action on man is transmitted and intercepted by the same substances that transmit and intercept the electrical current of a conductor charged by a Leyden jar or a Voltaic pile. In the water the shock can be conveyed to a considerable distance. No spark has ever been observed to issue from the body of the eel when excited.

Danger from
the shock.

Organ of
electricity

The gymnoti are objects of dread to the natives, and their presence is considered as the principal cause of the

CHAP. XV. want of fish in the pools of the Llanos. All the inhabitants of the waters avoid them; and the Indians asserted, that when they take young alligators and these animals in the same net, the latter never display any appearance of wounds, because they disable their enemies before they are attacked by them. It became necessary to change the direction of a road near Urituco, solely because they were so numerous in a river that they killed many mules in the course of fording it.

Aridity of the country

On the 24th March the travellers left Calabozo, and advanced southward. As they proceeded they found the country more dusty and destitute of herbage. The palm-trees gradually disappeared. From eleven in the morning till sunset the thermometer kept at 93° or 95°. Although the air was calm at the height of eight or ten feet, the ground was swept by little currents which raised clouds of dust. About four in the afternoon, they observed in the savannah a young Indian girl, twelve or thirteen years of age, quite naked, lying on her back, exhausted with fatigue and thirst, and with her eyes, nostrils, and mouth, filled with dust. Her breathing was stertorous, and she was unable to answer the questions put to her. Happily one of the mules was laden with water, the application of which to her face aroused her. She was at first frightened, but by degrees took courage, and conversed with the guides. As she could not be prevailed upon to mount the beasts of burden, nor to return to Urituco, she was furnished with some water; upon which she resumed her way, and was soon separated from her preservers by a cloud of dust.

Indian girl

Crocodiles.

In the night they forded the Rio Urituco, which is filled with crocodiles remarkable for their ferocity, although those of the Rio Tisnao in the neighbourhood are not at all dangerous. They were shown a hut or shed, in which a singular scene had been witnessed by their host of Calabozo, who, having slept in it upon a bench covered with leather, was awakened early in the

morning by a violent shaking, accompanied with a horrible noise. Presently an alligator two or three feet long issued from under the bed, and darted at a dog lying on the threshold, but missing him ran toward the river. When the spot where the bench stood was examined, the dried mud was found turned up to a considerable depth, where the alligator had lain in its state of torpidity or summer sleep. The hut being situated on the edge of a pool, and inundated during part of the year, the animal had no doubt entered at that period and concealed itself in the mire. The Indians often find enormous boas, or water-serpents, in the same lethargic state. CHAP. XV.
Singular
Incident.

On the 25th March they passed over the smoothest part of the steppes of Caraccas, the Mesa de Pavones. As far as the eye could reach, no object fifteen inches high could be discovered excepting cattle, of which they met some large herds accompanied by flocks of the *crotophaga ani*, a bird of a black colour with olive reflections. They were exceedingly tame, and perched upon the quadrupeds in search of insects. The Mesa de
Pavones.

Wherever excavations had been made, they found the rock to be old red sandstone or conglomerate, in which were observed fragments of quartz, kieselschiefer, and lydian stone. The cementing clay is ferruginous, and often of a very bright red. This formation, which covers an extent of several thousand square leagues, rests on the northern margin of the plains upon transition-slate, and to the south upon the granites of the Orinoco. Rocks.

After wandering a long time on the desert and pathless savannals of the Mesa de Pavones, they were agreeably surprised to find a solitary farm-house surrounded with gardens and pools of clear water. Farther on they passed the night near the village of San Geronymo del Guyaval, situated on the banks of the Rio Guarico, which joins the Apure. The ecclesiastic, who was a young man, and had no other habitation than his Farm-house
and village.

CHAP. XV. church, received them in the kindest manner. Crossing
Arrival at the Guarico they encamped in the plain, and early in
San Fer the morning pursued their way over low grounds which
nando. are often inundated. On the 27th they arrived at the
Villa de San Fernando, and terminated their journey
over the Llanos.

CHAPTER XVI.

Voyage down the Rio Apure.

San Fernando—Commencement of the Rainy Season—Progress of Atmospheric Phenomena—Cetaceous Animals—Voyage down the Rio Apure—Vegetation and Wild Animals—Crocodiles, Chiguire, and Jaguars—Don Ignacio and Donna Isabella—Water-fowl—Nocturnal Howlings in the Forest—Caribe-fish—Adventure with a Jaguar—Manatees—Mouth of the Rio Apure.

THE town of San Fernando, which was founded only in 1789, is advantageously situated on a large navigable river, the Apure, a tributary of the Orinoco, near the mouth of another stream which traverses the whole province of Varinas, all the productions of which pass through it on their way to the coast. It is during the rainy season, when the rivers overflow their banks and inundate a vast extent of country, that commerce is most active. At this period the savannahs are covered with water to the depth of twelve or fourteen feet, and present the appearance of a great lake, in the midst of which the farm-houses and villages are seen rising on islands scarcely elevated above the surface. Horses, mules, and cows, perish in great numbers, and afford abundant food to the zamuros or carrion-vultures, as well as to the alligators. The inhabitants, to avoid the force of the currents, and the danger arising from the trees carried down by them, instead of ascending the course of the rivers, find it safer to cross the flats in their boats.

CHAP. XVI.
Town of San Fernando.

Rainy season.

CHAP. XVI. San Fernando is celebrated for the excessive heat which prevails there during the greater part of the year. The travellers found the white sand of the shores, wherever it was exposed to the sun, to have a temperature of 126.5° , at two in the afternoon. The thermometer, raised eighteen inches above the sand, indicated 109° ; and at six feet, 101.7° . The temperature of the air in the shade was 97° . These observations were made during a dead calm, and when the wind began to blow the heat increased five degrees.

Thunder. On the 28th March, Humboldt and his companion being on the shore at sunrise, heard the thunder rolling all around, although as yet there were only scattered clouds, advancing in opposite directions toward the zenith. Deluc's hygrometer was at 53° , the thermometer stood at 74.7° , and the electrometer gave no particular indication. As the clouds mustered, the blue of the sky changed to deep azure, and then to gray; and when it was completely overcast the thermometer rose several degrees. Although a heavy rain fell, the travellers remained on the shore to observe the electrometer. When it was held at the height of six feet from the ground, the pith-balls generally separated only a few seconds before the lightning was seen. The separation was four lines. The electric charge remained the same for several minutes, and there were repeated oscillations from positive to negative. Toward the end of the storm the west wind blew with great impetuosity, and when the clouds dispersed the thermometer fell to 71.6° .

Meteorological phenomena. Humboldt states, that he enters into these details because Europeans usually confine themselves to a description of the impressions made on their minds by the solemn spectacle of a tropical thunder-storm; and because, in a country where the year is divided into two great seasons of drought and rain, it is interesting to trace the transition from the one to the other. In the valleys of Aragua, he had from the 18th of February observed clouds forming in the evening, and in the beginning of March the accumulation of vesicular va-

Object of observations.

pours became visible. Flashes of lightning were seen in the south, and at sunset Volta's electrometer regularly displayed positive indications, the separation of the pith-balls being from three to four lines. After the 26th of the latter month the electrical equilibrium of the atmosphere seemed broken, although the hygrometer still denoted great dryness.

CHAP. XVI.
Lightning.

The following is an account of the atmospheric phenomena in the inland districts to the east of the cordilleras of Merida and New Grenada, in the Llanos of Venezuela, and the Rio Meta, from the fourth to the tenth degree of north latitude, wherever the rains continue from May to October, and consequently include the period of the greatest heat, which is in July and August:—"Nothing can equal the purity of the atmosphere from December to February. The sky is then constantly without clouds, and should one appear, it is a phenomenon that occupies all the attention of the inhabitants. The breeze from the east and north-east blows with violence. As it always carries with it air of the same temperature, the vapours cannot become visible through refrigeration. Towards the end of February and the beginning of March, the blue of the sky is less intense; the hygrometer gradually indicates greater humidity; the stars are sometimes veiled by a thin stratum of vapours; their light ceases to be tranquil and planetary; and they are seen to sparkle from time to time at the height of 20° above the horizon. At this period the breeze diminishes in strength, and becomes less regular, being more frequently interrupted by dead calms. Clouds accumulate towards the south-east, appearing like distant mountains with distinct outlines. From time to time they are seen to separate from the horizon, and traverse the celestial vault with a rapidity which has no correspondence with the feebleness of the wind that prevails in the lower strata of the air. At the end of March the southern region of the atmosphere is illuminated by small electric explosions, like phosphorescent gleams confined to a single group of vapours.

Atmospheric
phenomena.

Humidity.

Clouds.

CHAP. XVI From this period the breeze shifts at intervals, and for several hours, to the west and south-west, affording a sure indication of the approach of the rainy season, which on the Orinoco commences about the end of April. The sky begins to be overcast, its azure colour disappears, and a gray tint is uniformly diffused over it. At the same time the heat of the atmosphere gradually increases, and instead of scattered clouds the whole vault of the heavens is overspread with condensed vapours. The howling-monkeys begin to utter their plaintive cries long before sunrise. The atmospheric electricity, which, during the period of the greatest drought, from December to March, had been almost constantly in the daytime from 1·7 to 2 lines to Volta's electrometer, becomes extremely variable after March. During whole days it appears null, and again, for some hours, the pith-balls of the electrometer diverge from three to four lines. The atmosphere, which in the torrid as in the temperate zone is generally in a state of positive electricity, passes alternately, in the course of eight or ten minutes, to the negative state. The rainy season is that of thunder-storms; and yet I have found, from numerous experiments made during three years, that at this season the electric tension is less in the lower regions of the atmosphere. Are thunder-storms the effect of this unequal charge of the different superimposed strata of the air? What prevents the electricity from descending towards the earth in a stratum of air which has become more humid since the month of March? At this period the electricity, in place of being diffused through the whole atmosphere, would seem to be accumulated on the outer envelope at the surface of the clouds. According to M. Gay Lussac, it is the formation of the cloud itself that carries the fluid toward the surface. The storm rises in the plains two hours after the sun passes through the meridian, and therefore shortly after the period of the maximum of the diurnal heat in the tropics. In the inland districts it is exceedingly rare to hear thunder at night or in the morning,

Heat

Atmospheric
electricity.Accumulation
of
electricity.

nocturnal thunder-storms being peculiar to certain valleys of rivers which have a particular climate." CHAP. XVI.

It may be interesting to present a very brief statement of Humboldt's explanation of these phenomena: Explanation of the phenomena.

—The season of rains and thunder in the northern equinoctial zone coincides with the passage of the sun through the zenith of the place, the cessation of the breezes or north-east winds, and the frequency of calms, and furious currents of the atmosphere from the south-east and south-west, accompanied with a cloudy sky. While the breeze from the north-east blows, it prevents the atmosphere from being saturated with moisture. The hot and loaded air of the torrid zone rises and flows off again towards the poles, while inferior currents from these last, bringing drier and colder strata, take the place of the ascending columns. In this manner the humidity, being prevented from accumulating, passes off towards the temperate and colder regions, so that the sky is always clear. When the sun, entering the northern signs, rises towards the zenith, the breeze from the north-east softens, and at length ceases; this being the season at which the difference of temperature between the tropics and the contiguous zone is least. The column of air resting on the equinoctial zone becomes replete with vapours, because it is no longer renewed by the current from the pole; clouds form in this atmosphere, saturated and cooled by the effects of radiation and the dilatation of the ascending air, which increases its capacity for heat in proportion as it is rarified. Electricity accumulates in the higher regions in consequence of the formation of the vesicular vapours, the precipitation of which is constant during the day, but generally ceases at night. The showers are more violent, and accompanied with electrical explosions, shortly after the maximum of the diurnal heat. These phenomena continue until the sun enters the southern signs, when the polar current is re-established, because the difference between the heat of the equinoctial and temperate regions is daily increasing. The air of the Vapour and clouds.

CHAP. XVI. tropics being thus renewed, the rains cease, the vapours are dissolved, and the sky resumes its azure tint.

Cetaceous animals.

At San Fernando, Humboldt observed in the river ong files of cetaceous animals resembling the common porpoise. The crocodiles seemed to dislike them, and dived whenever they approached. They were three or four feet long, and appear to be peculiar to the great streams of South America, as he saw some of them above the cataracts of the Orinoco, whither they could not have ascended from the sea.

Rainy season.

The rainy season had now commenced, and as the way to that river by land lies across an unhealthy and uninteresting flat, they preferred the longer way by the Rio Apure, and embarked in a large canoe or lancha, having a pilot and four Indians for crew. A cabin was constructed in the stern, of sufficient size to hold a table and benches, and covered with corypha-leaves. They

Provisions for a voyage.

put on board a stock of provisions for a month, while the Capuchin missionary, with whom they had lodged during their stay, supplied them with wine, oranges, and tamarinds. Fishing-instruments, fire-arms, and some casks of brandy, for bartering with the natives, were added to their store. On the 30th March, at four in the afternoon, they left San Fernando, accompanied by Don Nicolas Sopo, brother-in-law of the governor of the province. The river abounds in fish, manatees, and turtles, and its banks are peopled by numberless birds, of which the pauxi and guacharaca are the most useful to man. Passing the mouth of the Apurito, they coasted the island of the same name, formed by the Apure and Guarico, and which is seventy-six miles in length. On the banks they saw huts of the Yaruroes, who live by hunting and fishing, and are very skilful in killing jaguars, the skins of which they dispose of in the Spanish villages. The night was passed at Diamante, a small sugar-plantation.

Apurito.

On the 31st a contrary wind obliged them to remain on shore till noon, when they embarked, and as they proceeded found the river gradually widening; one of

its banks being generally sandy and barren, the other higher and covered with tall trees. Sometimes, however, it was bordered on both sides by forests, and resembled a straight canal 320 yards in breadth. Bushes of sauso (*Permesia castaneifolia*) formed along the margins a kind of hedge about four feet high, in which the jaguars, tapirs, and peccaris, had made openings for the purpose of drinking; and as these animals manifest little fear at the approach of a boat, the travellers had the pleasure of viewing them as they walked slowly along the shore, until they disappeared in the forest. When the sauso-hedge was at a distance from the current, crocodiles were often seen in parties of eight or ten, stretched out on the sand motionless, and with their jaws opened at right angles. These monstrous reptiles were so numerous, that throughout the whole course of the river there were usually five or six in view, although the waters had scarcely begun to rise, and hundreds were still buried in the mud of the savannahs. A dead individual which they found was 17 feet 9 inches long, and another, a male, was more than 23. This species is not a cayman or alligator, but a real crocodile, with feet dentated on the outer edge like that of the Nile. The Indians informed them, that scarcely a year passes at San Fernando without two or three persons being drowned by them, and related the history of a young girl of Urituco, who, by singular presence of mind, made her escape from one. Finding herself seized and carried into the water, she felt for the eyes of the animal, and thrust her fingers into them; when the crocodile let her loose, after biting off the lower part of her left arm. Notwithstanding the quantity of blood which she lost, she was still able to reach the shore by swimming with the right hand. Mungo Park's guide, Isaaco, effected his preservation from a crocodile by employing the same means. The motions of these animals are abrupt and rapid when they attack an object, although they move very slowly when not excited. In running they make a rustling noise, which seems to

CHAP. XVI.
Banks of the
Rio Apure.

Crocodiles.

Singular
escape from
a crocodile.

CHAP. XVI. ^{Motions of} proceed from their scales, and appear higher on their legs than when at rest, at the same time bending the back. They generally advance in a straight line, but can easily turn when they please. They swim with great facility, even against the most rapid current. On the Apure they seemed to live chiefly on the chiguire (*Cavia capybara*), which feed in herds on the banks, and are of the size of our pigs. These creatures have no weapons for defence, and are alternately the prey of the jaguars on land and of the crocodiles in the water.

Cano de la Tigrera. Stopping below the mouth of the Cano de la Tigrera, in a sinuosity called La Vuelta del-Joval, they measured the velocity of the current at its surface, which was only 3·4 feet in a second. Here they were surrounded by chiguire, swimming like dogs, with the head and neck out of the water. A large crocodile, which was sleeping on the shore in the midst of a troop of these animals, awoke at the approach of the canoe, and moved slowly into the stream without frightening the others. Near the Joval every thing assumed a wild and awful aspect. Here they saw an enormous jaguar stretched beneath the shade of a large zamang or mimosa. It had just killed a chiguire, which it held with one of its paws, while the zamuro-vultures were assembled in flocks around it. It was curious to observe the mixture of boldness and timidity which these birds exhibited, for although they advanced within two feet of the tiger, they instantly shrunk back at the least motion which he made. In order to examine more nearly their manners, the travellers went into the little boat ; when the tyrant of the forest withdrew behind the sauso-bushes, leaving his victim, which the vultures in the mean time attempted to devour, but were soon put to flight by his ushing into the midst of them.*

Jaguar.

Vultures.

* In the province of Tucuman the common mode of killing the jaguar is to trace him to his lair, by the wool left on the bushes, if he has carried off a sheep, or by means of a dog trained for the purpose. On finding the enemy the gaucho puts himself into a position for receiving him on the point of a bayonet or spear, at the first



JAGUAR, OR AMERICAN TIGER.
Does they say an enormous Jaguar crept out beneath the shade of a large mango or ash-tree.—Page 102.



Continuing to descend the river, they met with a great herd of chiguires that the tiger had dispersed, and from which he had selected his prey. These animals seemed not to be afraid of men, for they saw the travellers land without agitation, but the sight of a dog put them to flight. They ran so slowly that the people succeeded in catching two of them. It is the largest of the *Glires* or gnawing animals. Its flesh has a disagreeable smell of musk, although hams are made of it in the country, which are eaten during Lent; as this quadruped, according to ecclesiastical zoology, is esteemed a fish.

CHAP. XVI
Herd of
chiguires.

The travellers passed the night as usual in the open air, although in a plantation, the proprietor of which, a jaguar-hunter, half-naked and as brown as a Zambo, prided himself on being of the European race, and called his wife and daughter, who were as slightly clothed as himself, Donna Isabella and Donna Manuela. Humboldt had brought a chiguire; but his host assured him such food was not fit for white gentlemen like them, at the same time offering him venison. As this aspiring personage had neither house nor hut, he invited the strangers to sling their hammocks near his own, between two trees; which they accordingly did. They soon

Jaguar-
hunter.

Hospitality.

spring which he makes, and thus waits until the dogs drive him out; an exploit which he performs with such coolness and dexterity that there is scarcely an instance of failure. "In a recent instance, related by our capitaz, the business was not so quickly completed. The animal lay stretched at full length on the ground, like a gorged cat. Instead of showing anger and attacking his enemies with fury, he was playful, and disposed rather to parley with the dogs with good humour than to take their attack in sober earnestness. He was now fired upon, and a ball lodged in his shoulder; on which he sprung so quickly on his watching assailant, that he not only buried the bayonet in his body, but tumbled over the capitaz who held it, and they floundered on the ground together, the man being completely in his clutches. 'I thought,' said the brave fellow, 'I was no longer a capitaz, while I held my arm up to protect my throat, which the animal seemed in the act of seizing; but when I expected to feel his fangs in my flesh, the green fire of his eyes, which blazed upon me, flashed out in a moment. He fell on me, and expired at the very instant I thought myself lost for ever.'"—*Captain Andrews' Travels in South America*, vol. i. p. 219.

CHAP. XVI. found reason, however, to regret that they had not obtained better shelter ; for after midnight a thunder-storm came on, which wetted them to the skin. Donna Isabella's cat had perched on one of the trees, and fell into a cot, the inmate of which imagined he was attacked by some wild beast, and could hardly be quieted.

Weather. At sunrise the lodgers took leave of Don Ignacio and his lady, and proceeded on their voyage. The weather was a little cooler, the thermometer having fallen from 86° to 75° ; but the temperature of the river continued at 79° or 80°. One might imagine that on smooth ground, where no eminence can be distinguished, the stream would have hollowed out an even bed for itself ; but this is by no means the case ; the two banks not opposing equal resistance to the water. Below the Joval the mass of the current is a little wider, and forms a perfectly straight channel, margined on either side by lofty trees. It was here about 290 yards broad. They passed a low island densely covered by flamingoes, roseate spoonbills, herons, and water-hens, which presented a most diversified mixture of colours. On the right bank they found a little Indian mission, consisting of sixteen huts constructed of palm-leaves, and inhabited by a tribe of the Guamoses. These Christians were unable to furnish them with the provisions which they wanted, but hospitably offered them dried fish and water. The night was spent on a bare and very extensive beach. The forest being impenetrable, they had great difficulty in obtaining dry wood to light fires for the purpose of keeping off the wild beasts. But the night was calm, with beautiful moonlight. Finding no tree on the banks, they stuck their oars in the sand, and suspended their hammocks upon them. About eleven there arose in the wood so terrific a noise that it was impossible to sleep. The Indians distinguished the cries of sapajous, alouates, jaguars, cougars, pecaris, sloths, curassows, parraquas, and other gallinaceous birds. When the tigers approached the edge of the forest, a dog which the travellers had, began to howl

Scenery of the Apure.

Bivouac on the shore.

and seek refuge under their cots. Sometimes, after a long silence, the cry of the ferocious animals came from the tops of the trees, when it was followed by the sharp and long whistling of the monkeys. Humboldt supposes the noise thus made by the inhabitants of the thicket, at certain hours of the night, to be the effect of some contest that has arisen among them. CHAP. XVI.

On the 2d April they set sail before sunrise. The river was ploughed by porpoises, and the shore crowded with aquatic birds; while some of the latter, perched on the floating timber, were endeavouring to surprise the fish that preferred the middle of the stream. The navigation is rather dangerous, on account of the large trees which remain obliquely fixed in the mud, and the canoe touched several times. Near the island of Carizales they saw enormous trunks covered with plotuses or darters, and below it observed a diminution of the waters of the river, owing to infiltration and evaporation. Near the Vuelta de Basilio, where they landed to gather plants, they saw on a tree two beautiful jet-black monkeys of an unknown species, and also a nest of iguanas, which was pointed out by the Indians. The flesh of this lizard is very white, and, next to that of the armadillo, is the best food to be found in the huts of the natives. Towards evening it rained, and swallows were seen skimming along the water. They also saw a flock of parrots pursued by hawks. The night was passed on the beach. Porpoisea.
Black
monkeys.

On the 3d they proceeded down the river in their solitary course. The sailors caught the fish known in the country by the name of caribe; which, although only four or five inches in length, attacks persons who go into the water, and with its sharp triangular teeth often tears considerable portions of flesh from their legs. When pieces of meat are cast into the river, clouds of these little fishes appear in a few minutes. There are three varieties in the Orinoco; one of which seems to be the *Salma rhombeus* of Linnæus. At noon they stopped in a desert spot called Algodonal, when Hum- Caribe fish.

- CHAP. XVI** boldt left his companions and went along the beach to observe a group of crocodiles sleeping in the sun. Some little herons of a white colour were walking along their backs, and even on their heads. As he was proceeding, his eyes directed towards the river, he discovered recent footmarks of a beast of prey, and turning toward the forest, found himself within eighty steps of an enormously large jaguar. Although extremely frightened, he yet retained sufficient command of himself to follow the advice which the Indians had so often given, and continued to walk without moving his arms, making a large circuit toward the edge of the water. As the distance increased he accelerated his pace, and at length, judging it safe to look about, did so, and saw the tiger in the same spot. Arriving at the boat out of breath, he related his adventure to the natives, who seemed to think it nothing extraordinary. In the evening they passed the mouth of the Cano del Manati, so named on account of the vast number of manatees caught there.
- Group of crocodiles.**
- Escape from a Jaguar.**
- Manatees.** This aquatic herbivorous animal generally attains the length of ten or twelve feet, and abounds in the Orinoco below the cataracts, the Rio Meta, and the Apure. The flesh, although very savoury and resembling pork, is considered unwholesome; but it is in request during Lent, being classed by the monks among fishes. The fat is used for lamps in the churches, as well as for cooking; while the hide is cut into slips to supply the place of cordage. Whips are also made of it in the Spanish colonies for the castigation of negroes and other slaves. The fires lighted by the boatmen on the shore attracted the crocodiles and dolphins. Two persons kept watch during the night. A jaguar with her cub approached the encampment, but was driven away by the attendants; and soon after the dog was bitten in the nose by a large bat or vampire.
- Its uses.**
- Tigers.** On the 4th they intended to pass the night at Vuelta del Palmito; but as the Indians were going to sling the hammocks, they found two tigers concealed behind a tree, and it was judged safer to re-embark and sleep on

the island of Apurito. Multitudes of gnats made their appearance regularly at sunset, and covered their faces and hands. On the 5th they were much struck by the diminution the waters of the Apure had undergone, which they attributed chiefly to absorption by the sand and evaporation. It was only from 128 to 170 yards broad, and about twenty feet deep. Humboldt estimates the mean fall of this river at 14 inches in a mile. The canoe touched several times on shoals as they approached the point of junction, and it became necessary to tow it by means of a line.

CHAP. XVI

Gnats.

CHAPTER XVII.

Voyage up the Orinoco.

Ascent of the Orinoco—Port of Encaramada—Traditions of a Universal Deluge—Gathering of Turtles' Eggs—Two Species described—Mode of collecting the Eggs and of manufacturing the Oil—Probable Number of these Animals on the Orinoco—Decorations of the Indians—Encampment of Pararuma—Height of the Inundations of the Orinoco—Rapids of Tabage.

CHAP. XVII. LEAVING the Río Apure the travellers entered the Orinoco, and presently found themselves in a country of an entirely different aspect. As far as the eye could reach there lay before them a sheet of water, the waves of which, from the conflict of the breeze and the current, rose to the height of several feet. The long files of herons, flamingoes, and spoonbills, which were observed on the Apure, had disappeared; and all that supplied the place of those multitudes of animated beings by whom they had been lately accompanied, was here and there a crocodile swimming in the agitated stream. The horizon was bounded by a girdle of forests, separated from the river by a broad beach, the bare and parched surface of which refracted the solar rays into the semblance of pools.

Punta
Curiquima

The wind was favourable for sailing up the Orinoco; but the short broken waves at the junction of the two rivers were exceedingly disagreeable. They passed the Punta Curiquima, a granitic promontory, between which and the mouth of the Apure the breadth of the stream was ascertained to be 4063 yards, and in the rainy season it extends to 11,760. The temperature of the water was in the middle of the current 82·9°, and near

the shores, 84°6'. They first went up toward the south-west as far as the shore of the Guaricoto Indians on the left bank, and then toward the south. The mountains of Encaramada, forming a continued chain from west to east, seemed to rise from the water as distant land rises on the horizon at sea. The beach was composed of clay intermixed with scales of mica, deposited in very thin strata. At the port of Encaramada, where they stopped for some time, they met with a Carib cacique going up the river in his canoe to gather turtles' eggs. He was armed with a bow and arrows, as were his attendants, and, like them, he was naked and painted red. These Indians were tall and athletic, and, with their hair cut straight across the forehead, their eyebrows painted black, and their gloomy but animated countenances, had a singular appearance. The travellers were surprised to find that the anterior portion of the cranium is not so depressed as those of the Caribs are usually represented to be. The women carried their infants on their backs. The shore is here formed by a rock forty or fifty feet high, composed of blocks of granite piled upon each other; the surface of which was of a dark-gray colour, although the interior was reddish-white. The night was passed in a creek opposite the mouth of the Rio Cabullare. The evening was beautiful, with moonlight; but towards twelve the north-east wind blew so violently that they became apprehensive for the safety of their canoe.

On the 6th, continuing to ascend, they saw the southern side of the mountains of Encaramada, which stretch along the right bank of the river, and are inhabited by Indians of a gentle character, and addicted to agriculture. There is a tradition here, and elsewhere on the Orinoco, among the natives, "That at the time of the Great Waters, when their fathers were obliged to betake themselves to their canoes in order to escape the general inundation, the waves of the sea beat upon the rocks of Encaramada." When the Tamanacs are asked how the human race survived this great deluge, they

CHAP. XVII.
Encaramada.

Carib
Indians

Indian
traditions.

CHAP. XVII. say, "That a man and a woman saved themselves upon
 The deluge. a high mountain called Tamanacu, situated on the bank
 of the Aseveru, and that, throwing behind them, over
 their heads, the fruits of the Mauritia palm, they saw
 arising from the nuts of these fruits the men and women
 who re-peopled the earth." Thus among the natives of
 America, a fable similar to that of Pyrrha and Deucalion
 commemorates the grand catastrophe of a general inun-
 dation. Humboldt, in reference to the same event,
 mentions that hieroglyphic figures are often found along
 the Orinoco sculptured on rocks now inaccessible but by
 scaffolding, and that the natives, when asked how these
 figures could have been made, answer with a smile, as
 relating a fact of which a stranger only could be ignorant,
 "That at the period of the Great Waters their fathers
 went to that height in boats."

Correspon-
 dence
 to classic
 fables.

Interest of
 such tradi-
 tions.

Their uni-
 formity.

"These ancient traditions of the human race," says
 Humboldt, "which we find dispersed over the surface
 of the globe, like the fragments of a vast shipwreck, are
 of the greatest interest in the philosophical study of our
 species. Like certain families of plants, which, not-
 withstanding the diversity of climates and the influence
 of heights, retain the impress of a common type, the
 traditions respecting the primitive state of the globe
 present among all nations a resemblance that fills us
 with astonishment; so many different languages, be-
 longing to branches which appear to have no connexion
 with each other, transmit the same facts to us. The
 substance of the traditions respecting the destroyed races
 and the renovation of nature is every where almost the
 same, although each nation gives it a local colouring. In
 the great continents, as in the smallest islands of the Pa-
 cific Ocean, it is always on the highest and nearest moun-
 tain that the remains of the human race were saved; and
 this event appears so much the more recent the more un-
 cultivated the nations are, and the shorter the period since
 they have begun to acquire a knowledge of themselves.
 When we attentively examine the Mexican monuments
 anterior to the discovery of America,—penetrate into

the forests of the Orinoco, and become aware of the smallness of the European establishments, their solitude, and the state of the tribes which retain their independence,—we cannot allow ourselves to attribute the agreement of these accounts to the influence of missionaries and to that of Christianity upon national traditions. Nor is it more probable that the sight of marine bodies, found on the summits of mountains, presented to the tribes of the Orinoco the idea of those great inundations which for some time extinguished the germs of organic life upon the globe.—The country which extends from the right bank of the Orinoco to the Casiquiare and the Rio Negro consists of primitive rocks. I saw there a small deposit of sandstone or conglomerate, but no secondary limestone, and no trace of petrifications.”

At eleven in the morning the travellers landed on an island celebrated for the turtle-fishery, or the “harvest of eggs,” which takes place annually. Here they found encamped more than 300 Indians of different races, each tribe, distinguished by its peculiar mode of painting, keeping separate from the rest, together with a few white men who had come to purchase egg-oil from them. The missionary of Uruana, whose presence was necessary to procure a supply for the lamp of the church and keep the natives in order, received the strangers with kindness, and made the tour of the island with them; showing them, by means of a pole which he thrust into the sand, the extent of the stratum of eggs that had been deposited wherever there were no eminences. The Indians asserted, that in coming up the Orinoco, from its mouth to the junction of the Apure, there is no place where eggs can be collected in abundance; and the only three spots where the turtles assemble annually in great numbers are situated between the mouth of the Apure and the great cataracts. These animals do not seem to pass beyond the falls, the species found above Ature and Maypures being different.

The arrau or tortuga, which deposits the eggs that are so much valued on the Lower Orinoco, is a large fresh-

CHAP. XVII.

Slight influence of the missionaries.

Turtle eggs.

Uruana missionaries.

Fresh-water tortoise.

CHAP. XVII. water tortoise, with webbed feet, a very flat head, a deep groove between the eyes, and an upper shell composed of five central, eight lateral, and twenty-four marginal scutella or plates. The colour is dark-gray above and orange beneath. When of full size it weighs from forty to fifty pounds. The eggs are much larger than those of a pigeon, and are covered with a calcareous crust.

The terekay. The terekay, the species which occurs above the cataracts, is much smaller. It has the same number of dorsal plates, but the colour is olive-green, with two spots of red mixed with yellow on the top of the head, and a prickly appendage under the chin. The eggs have an agreeable taste, and are much sought after, but are not deposited in masses like those of the tortuga. This variety is found below the cataracts as well as in the Apure, the Urituco, the Guarico, and the small rivers of the Llanos of Caraccas.

Deposition of eggs. The period at which the arrau deposits its eggs is when the river is lowest. About the beginning of February these creatures issue from the water and warm themselves on the beach, remaining there a great part of the day. Early in the month of March they assemble on the islands where they breed, when thousands are to be seen ranged in files along the shores. The Indians place sentinels at certain distances, to prevent them from being disturbed, and the people who pass in boats are told to keep in the middle of the river. The laying of the eggs begins soon after sunset, and is continued throughout the night. The animal digs a hole three feet in diameter and two in depth, with its hind feet, which are very long and furnished with crooked claws. So pressing is the desire which it feels to get rid of its burden, that great confusion prevails, and an immense number of eggs is broken. Some of the tortoises are surprised by day before they have finished the operation, and, becoming insensible to danger, continue to work with the greatest diligence even in the presence of the fishers.

The Indians assemble about the beginning of April,

and commence operations under the direction of the CHAP. XVII. missionaries, who divide the egg-ground into portions. The leading person among them first examines, by ^{Harvest of} means of a long pole or cane, how far the bed extends and then allots the shares. The natives remove the earth with their hands, gather up the eggs, and carry them in baskets to the camp, where they throw them into long wooden troughs filled with water. They are next broken and stirred, and remain exposed to the sun, until the yoke, which swims at the surface, has time to inspissate, when it is taken off and boiled. The oil thus ^{Mode of} obtained is limpid and destitute of smell, and is used for ^{making oil.} lamps as well as for cooking. The shores of the missions of Uruana furnish 1000 botijas or jars annually, and the three stations jointly may be supposed to furnish 5000. It requires 5000 eggs to fill a jar; and if we estimate at 100 or 116 the number which one tortoise produces, and allow one-third to be broken at the time of laying, we may presume that 330,000 of these animals assemble every year, and lay 33,000,000 of eggs. This calculation, however, is much below the truth. Many of them lay only 60 or 70; great numbers of them again ^{Number of} are devoured by jaguars; the Indians take away a ^{tortoises.} considerable quantity to eat them dried in the sun, and break nearly as many while gathering them; and, besides, the proportion that is hatched is such, that Humboldt saw the whole shore near the encampment of Uruana swarming with young ones. Moreover, all the arraus do not assemble on the three shores of the encampments, but many lay elsewhere. The number which annually deposite their eggs on the shores of the Lower Orinoco may therefore be estimated at little short of a million. The travellers were shown the shells of large turtles which had been emptied by the jaguars. These animals surprise them on the sand, and turn them on their back in order to devour them at their ease: they dig up the eggs also; and, together with the gallinazo-vulture and the herons, destroy thousands of their brood.

CHAP. XVII. After procuring some fresh provision, and taking leave of the missionary, they set sail in the afternoon. The wind blew in squalls, and after they had entered the mountainous part of the country, they found the canoe not very safe when under sail; but the master was desirous of showing off to the Indians, and in going close upon the wind almost upset his vessel, which filled with water and nearly foundered. In the evening they landed on a barren island, where they supped under a beautiful moonlight, with turtle-shells for seats, and indulged their imagination with the picture of a shipwrecked man, wandering on the desert shores of the Orinoco amid rivers full of crocodiles and caribe fishes. The night was intensely hot, and not finding trees on which to sling their hammocks, they slept on skins spread on the ground. To their surprise the jaguars swam to the island, although they had kindled fires to prevent them; but these animals did not venture to attack them.

Navigation of the Orinoco.

Moonlight scene.

Mouth of the Rio Arauca.

Dangers of the rivers.

On the 7th they passed the mouth of the Rio Arauca, which is frequented by immense numbers of birds. They also saw the mission of Uruana, at the foot of a mountain composed of detached blocks of granite, in the caverns formed by which hieroglyphic figures are sculptured. Measuring the breadth of the Orinoco here, they found it, at a distance of 670 miles from the mouth, to be 5700 yards, or nearly three miles. The temperature of the water at its surface was 82°. As the strength of the current increased, the progress of the boat became much slower, while at one time the woods deprived them of the wind, and at another a violent gust descended from the mountain-passes. Opposite the lake of Capanaparo, which communicates with the river, the number of crocodiles was increased. The Indians asserted that they came in troops to the water from the savannahs, where they lie buried in the solid mud until the first showers awaken them. Humboldt remarks, that the dry season of the torrid zone corresponds to the winter of the temperate regions of the globe; and that while the alligators of North America become torpid through

excess of cold, the crocodiles of the Llanos are reduced to the same state through deficiency of moisture. CHAP. XVII.

They now entered the passage of the Baraguan, where the Orinoco is hemmed in by precipices of granite, forming part of a range of mountains through which it has found or forced a channel. Like all the other granitic hills which they observed on this river, they were formed of enormous cubical masses piled upon each other. Landing in the middle of the strait, they found the breadth of the stream to be 1895 yards. They looked in vain for plants in the fissures of the rocks; but the stones were covered with multitudes of lizards. There was not a breath of wind, and the heat was so intense that the thermometer placed against the rock rose to 122·4°. “How vivid,” says Humboldt, “is the impression which the noontide quiet of nature produces in these burning climates! The beasts of the forest retire to the thickets, and the birds conceal themselves among the foliage or in the crevices of rocks. Yet amid this apparent silence, should one listen attentively, he hears a stifled sound, a continued murmur, a hum of insects, that fill the lower strata of the air. Nothing more adapted to excite in man a sentiment of the extent and power of organic life. Myriads of insects crawl on the ground, and flutter round the plants scorched by the heat of the sun. A confused noise issues from every bush, from the decayed trunks of the trees, the fissures of the rocks, and from the ground, which is undermined by lizards, millepeds, and blindworms. It is a voice proclaiming to us that all nature breathes, that under a thousand different forms life is diffused in the cracked and dusty soil, as in the bosom of the waters, and in the air that circulates around us.” The water of the river was very disagreeable here, as it had a musky smell and a sweetish taste. In some parts it was pretty good; but in others it seemed loaded with gelatinous matter, which the natives attribute to putrefied crocodiles.

After sleeping at the foot of an eminence they continued their voyage, and passed the mouths of several

CHAP. XVII.

Beach of
Pararuma.

rivers ; and on the 9th arrived, early in the morning, at the beach of Pararuma, where they found an encampment of Indians, who had assembled to search the sands for turtles' eggs. The pilot who had brought them from San Fernando de Apure would not undertake to accompany them farther ; but they procured a boat from one of the missionaries who had come to the egg-harvest.

Encamp-
ment of
Indians.

This assemblage or encampment afforded to the travellers an interesting subject of study. "How difficult," says Humboldt, "to recognise in this infancy of society, this collection of dull, taciturn, and unimpassioned Indians, the original character of our species! Human nature is not seen here arrayed in that gentle simplicity of which poets in every language have drawn such enchanting pictures. The savage of the Orinoco appeared to us as hideous as the savage of the Mississippi, described by the philosophical traveller who best knew how to paint man in the various regions of the globe. One would fain persuade himself that these natives of the soil, crouched near the fire, or seated on large shells of turtles, their bodies covered with earth and grease, and their eyes stupidly fixed for whole hours on the drink which they are preparing, far from being the original type of our species, are a degenerated race, the feeble remains of nations which, after being long scattered in the forests, have been again immersed in barbarism."

Red paints.

Red paint is the ordinary decoration of these tribes. The most common kind is obtained from the seeds of the *Bixa orellana*, and is called anotto, achote, or roucou. Another much more expensive species is extracted from the leaves of *Bignonia chica*. Both these are red ; but a black ingredient is obtained from the *Genipa Americana*, and is called caruto. These pigments are mixed with turtle-oil or grease, and are variously applied according to national or individual taste. The Caribs and Otomacs colour only the head and hair, while the Salivas smear the whole body ; but there prevails in general as great a diversity in the mode of staining as is found in Europe in respect to dress ; and at Pararuma the travellers saw

some Indians painted with a blue jacket and black buttons. Women advanced in years are fonder of being thus ornamented than the younger ladies; and so expensive is this mode of decoration, that an industrious man can hardly gain enough by the labour of a fortnight to adorn himself with *chica*, of which the missionaries make an article of traffic. After all, the paintings that cost so much are liable to be effaced by a heavy shower; although the *caruto* long resists the action of water, as the travellers found by disagreeable experience; for having one day in sport marked their faces with spots and strokes of it, it was not entirely removed till after a long period. It has been supposed that this usage prevents the Indians from being stung by insects: but this was found to be incorrect. The preference given by the American tribes to the red colour, Humboldt supposes to be owing to the tendency which nations feel to attribute the idea of beauty to whatever characterizes their national complexion.

CHAP. XVII.

Modes of painting.

Difficulty of removal.

The encampment of Pararuma also afforded the travellers an opportunity of examining several animals they had not before seen alive, and which the Indians brought to exchange with the missionaries for fish-hooks and other necessaries. Among these specimens were gallitoes, or rock-manakins, monkeys of different species, of which the *titi* or *Simia sciurea* seems to have been a special favourite with Humboldt. He mentions a very interesting fact illustrative of the sagacity of this creature. One which he had purchased of the natives distinguished the different plates of a work on natural history so well, that when an engraving which contained zoological representations was placed before it, it rapidly advanced its little hand to catch a grasshopper or a wasp; which was the more remarkable as the figures were not coloured. Humboldt observes, that he never heard of even the most perfect picture of hares or deer producing the least effect upon a hound, and doubts if there be a well-ascertained example of a dog having recognised a full-length portrait of its master.

Native animals.

Sagacity of the titi.

CHAP. XVII. The canoe which they had procured was forty-two feet long and three broad. The missionary of Atures and Maypures had offered to accompany them as far as the frontiers of Brazil, and made preparations for the voyage. Two Indians who were to form part of the crew were chained during the night to prevent their escape; and on the morning of the 10th the company set out. The vessel was found to be extremely incommodious. To gain something in breadth a kind of frame had been extended over the gunwale in the hinder part of it; but the roof of leaves which covered it was so low, that the travellers were obliged to lie down, or sit nearly double, while in rainy weather the feet were liable to be wetted. The natives, seated two and two, were furnished with paddles three feet long, and rowed with surprising uniformity to the cadence of a monotonous and melancholy song. Small cages containing birds and monkeys were suspended to the shed, and the dried plants and instruments were placed beneath it. To their numerous inconveniences was added the continual torment of the mosquitoes, which they were unable by any means to alleviate. Every night, when they established their watch, the collection of animals and instruments occupied the centre, around which were placed first their own hammocks, and then those of the Indians, while fires were lighted to intimidate the jaguars. At sunrise the monkeys in the cages answered the cries of those in the forests, affording an affecting display of sympathy between the captive and the free.

Preparations for the voyage.

Incommodious vessel.

Mosquitoes.

Islands.

Above the deserted mission of Pararuma the river is full of islands, and divides into several branches. Its total breadth is about 6395 yards. The country becomes more wooded. A granitic prism, terminated by a flat surface covered with a tuft of trees, rises to the height of 213 feet in the midst of the forest. Farther on, the river narrows; and upon the east is an eminence, on which the Jesuits formerly maintained a garrison for protecting the missions against the inroads of the Caribs, and for extending what, in the Spanish colonies, was

called the conquest of souls, which of course was effected through the conquest of bodies. The soldiers made incursions into the territories of the independent Indians, killed all who offered resistance, burned their huts, destroyed the plantations, and made prisoners of the old men, women, and children, who were afterwards divided among their establishments. The river again contracted, and rapids began to make their appearance, the shores becoming sinuous and precipitous. In a bay, between two promontories of granite, they landed at what is called the Port of Carichana, and proceeded to the mission of that name, situated at the distance of two miles and a half from the bank, where they were hospitably received at the priest's house. The Christian converts at this station were Salivas, a social and mild people, having a great taste for music.

Among these Indians they found a white woman, the sister of a Jesuit of New Grenada, and experienced great pleasure in conversing with her without the aid of a third person. In every mission, says Humboldt, there are at least two interpreters, for the purpose of communicating between the monks and the catechumens, the former seldom studying the language of the latter. They are natives, somewhat less stupid than the rest, but ill adapted for their office. They always attended the travellers in their excursions; but little more could be got from them than a mere affirmation or negation. Sometimes, in attempting to hold intercourse with the Indians, he preferred the language of signs,—a method which he recommends to travellers, as the variety of languages spoken on the Meta, Orinoco, Casiquiare, and Rio Negro, is so great, that no one could ever make himself understood in them all.

The scenery around the mission of Carichana appeared delightful. The village was situated on a grassy plain, bounded by mountains. Banks of rock, often more than 850 feet in circumference, scarcely elevated a few inches above the savannahs, and nearly destitute of vegetation, gave a peculiar character to the country. On these

CHAP. XVII.

Fanatic
violence.Port of
Carichana.White
woman.

Interpreters

Use of signs.

Fine
scenery.

CHAP. XVII. stony flats they eagerly observed the rising vegetation in the different stages of its development: Lichens cleaving the rock and collected into crusts; a few succulent plants growing among little portions of quartz-sand; and tufts of evergreen shrubs springing up in the black mould deposited in the hollows. At the distance of eight or ten miles from the religious house they found a rich and diversified assemblage of plants, among which M. Bonpland obtained numerous new species. Here grew the *Dipterix odorata*, which furnishes excellent timber, and of which the fruit is known in Europe by the name of tonkay or tongo bean.

Marks of
inundations.

In a narrow part of the river the marks of the great inundations were 45 feet above the surface; but at various places black bands and erosions are seen, 106 or even 138 feet above the present highest increase of the waters. "Is this river, then," says Humboldt, "the Orinoco, which appears to us so imposing and majestic, merely the feeble remnant of those immense currents of fresh water which, swelled by Alpine snows or by more abundant rains, every where shaded by dense forests, and destitute of those beaches that favour evaporation, formerly traversed the regions to the east of the Andes, like arms of inland seas! What must then have been the state of those low countries of Guiana, which now experience the effects of annual inundations! What a prodigious number of crocodiles, lamantines, and boas, must have inhabited these vast regions, alternately converted into pools of stagnant water and arid plains! The more peaceful world in which we live has succeeded to a tumultuous world. Bones of mastodons and real American elephants are found dispersed over the plateaus of the Andes. The megatherium inhabited the plains of Uruguay. By digging the earth more deeply in high valleys, which at the present day are unable to nourish palms or tree-ferns, we discover strata of coal containing gigantic remains of monocotyledonous plants. There was therefore a remote period, when the tribes of vegetables were differently distributed; when the ani-

Former
state of the
country.

Antediluvian
world.

mals were larger, the rivers wider and deeper. There CHAP. XVII.
 stop the monuments of nature which we can consult. American
 We are ignorant if the human race, which at the time races.
 of the discovery of America scarcely presented a few
 feeble tribes to the east of the Cordilleras, had yet
 descended into the plains, or if the ancient tradition of
 the Great Waters, which we find among all the races of
 the Orinoco, Erevato, and Caura, belongs to other cli-
 mates, whence it had been transferred to this part of the
 new continent."

On the 11th they left Carichana at two in the after- Piedra del
 noon, and found the river more and more encumbered Tigre.
 by blocks of granite. At the large rock known by the
 name of Piedra del Tigre, the depth is so great that no
 bottom can be found with a line of 140 feet. Towards
 evening they encountered a thunder-storm, which for a
 time drove away the mosquitoes that had tormented
 them during the day. At the cataract of Cariven the Cataract of
 current was so rapid that they had great difficulty in Cariven.
 landing; but at length two Saliva Indians swam to the
 shore, and drew the canoe to the side with a rope. The
 thunder continued a part of the night, and the river in-
 creased considerably. The granitic rock on which they
 slept is one of those from which travellers on the
 Orinoco have heard subterranean sounds, resembling
 those of an organ, emitted about sunrise. Humboldt
 supposes that these must be produced by the passage of
 rarified air through the fissures, and seems to think,
 that the impulse of the fluid against the elastic scales of
 mica which intercept the crevices may contribute to
 modify their expression.*

* Many examples of mysterious sounds produced under similar
 circumstances are on record. In the autumn of 1828, a recent tra-
 veller crossing the Pyrenees, when in a wild pass with the Mala-
 detta mountain opposite, heard "a dull, low, moaning, Æolian sound,
 which alone broke upon the deathly silence, evidently proceeding
 from the body of this mighty mass." The air was perfectly calm,
 and clear to an extraordinary degree; no waterfall could be seen
 even with the aid of a telescope, and no cause could be assigned for
 the phenomenon, unless the sun's rays, "at that moment impinging

CHAP. XVII. On the 12th they set off at four in the morning. The Indians rowed 12 hours and a half without intermission, during which time they took no other nourishment than cassava and plantains. The bed of the river, to the length of 1280 yards, was full of granite rocks, the channels between which were often very narrow, inso-

Indian
rowers.

much that the canoe was sometimes jammed in between two blocks. When the current was too strong the sailors leaped out and warped the boat along. The rocks were of all dimensions, rounded, very dark, glossy like lead, and destitute of vegetation. No crocodiles were seen in these rapids. The left bank of the Orinoco, from Cabruto to the mouth of the Rio Serianico, a distance of nearly two degrees of latitude, is entirely uninhabited; but to the westward of these rapids an enterprising individual, Don Felix Relinchon, had formed a village of Jaruro and Otomac Indians. At nine in the morning they arrived at the mouth of the Meta, which, next to the Guaviare, is the largest river that joins the Orinoco. At the union of these streams the scenery is of a very impressive character. Solitary peaks rise on the eastern side, appearing in the distance like ruined castles, while vast sandy shores intervene between the bank and the forests. They passed two hours on a large rock in the middle of the Orinoco, upon which Humboldt succeeded in fixing his instruments, and in

Indian
village.

in all their glory on every point and peak of the snowy heights," had some share "in vibrating these mountain-chords."—*N. M. Mag.* xxx. 341.—The granite statue of Memnon is well known to have emitted sounds when the morning beams darted upon it; and MM. Jomard, Jollois, and Devilliers, heard a noise resembling that of the breaking of a string, which proceeded at sunrise from a monument of granite situated near the centre of the spot on which stands the palace of Carnac. Singular sounds have been heard from the interior of a mountain near Tor, in Arabia Petræa. They are familiar to the natives, who ascribe them to a convent of monks miraculously preserved under ground, and were heard by M. Seetzen and Mr Gray, the only European travellers who have visited the place. For an account of these curious phenomena, the reader may be referred to Dr Brewster's Letters on Natural Magic, forming No XXXIII. of the Family Library.

determining the longitude of the embouchure of the CHAP. XVII.
 Meta,—a river which will one day be of great political River Meta.
 importance to the inhabitants of Guiana and Venezuela,
 as it is navigable to the foot of the Andes of New Grenada.
 Above this point the current was comparatively free
 from shoals; and in the evening they reached the
 Rapids of Tabaje. As the Indians would not venture to
 pass them they were obliged to land, and repose on a
 craggy platform having a slope of more than eighteen
 degrees, and having its crevices filled with bats. The
 cries of the jaguar were heard very near during the
 whole night; the sky was of a tremendous blackness;
 and the hoarse noise of the rapids blended with the
 thunder which rolled at a distance amongst the woods.

Early in the morning they cleared the rapids, and Rapids of
 Tabaje.
 disembarked at the new mission of San Borja, where
 they found six houses inhabited by uncatechised Guahiboes,
 who differed in nothing from the wild natives. The faces
 of the young girls were marked with black spots. This
 people had not painted their bodies, and several of them
 had beards, of which they seemed proud, taking the
 travellers by the chin, and showing by signs that they
 were like themselves. In continuing to ascend the river
 they found the heat less intense, the temperature during
 the day being 79° or 81·5°, and at night about 75°; but
 the torment of the mosquitoes increased. The crocodiles
 which they saw were all of the extraordinary size of 24
 or 25 feet.

The night was spent on the beach; but the sufferings Island of
 Guachaco.
 inflicted by the flies induced the travellers to start at
 five in the morning. On the island of Guachaco, where
 they stopped to breakfast, they found the granite covered
 by a sandstone or conglomerate, containing fragments of
 quartz and felspar cemented by indurated clay, and
 exhibiting small veins of brown iron-ore. Passing the
 mouth of the Rio Parueni, they slept on the island of
 Panumana, which they found rich in plants, and where
 they again observed the low shelves of rock partially
 coated with the vegetation which they had admired at
 Carichana.

CHAPTER XVIII.

Voyage up the Orinoco continued.

Mission of Atures—Epidemic Fevers—Black Crust of Granitic Rocks—Causes of Depopulation of the Missions—Falls of Apures—Scenery—Anecdote of a Jaguar—Domestic Animals—Wild Man of the Woods—Mosquitoes and other poisonous Insects—Mission and Cataracts of Maypures—Scenery—Inhabitants—Spice-trees—San Fernando de Atabapo—San Baltasar—The Mother's Rock—Vegetation—Dolphins—San Antonio de Javita—Indians—Elastic Gum—Serpents—Portage of the Pimichin—Arrival at the Rio Negro, a Branch of the Amazon—Ascent of the Casiquiare.

CHAP. XVIII. LEAVING the island of Panumana at an early hour the navigators continued to ascend the Orinoco, the scenery on which became more interesting the nearer they approached the great cataracts. The sky was in part obscured, and lightnings flashed among the dense clouds; but no thunder was heard. On the western bank of the river they perceived the fires of an encampment of Guahiboes, to intimidate whom some shots were discharged by the direction of the missionary. In the evening they arrived at the foot of the great fall, and passed the night at the mission of Atures in its neighbourhood. The flat savannah which surrounds the village seemed to Humboldt to have formerly been the bed of the Orinoco.

Interesting
scenery.

Native
encamp-
ment.

This station was found to be in a deplorable state, the Indians having gradually deserted it until only

forty-seven remained. At its foundation in 1748 several tribes had been assembled, which subsequently dispersed, and their places were supplied by the Guahiboes, who belong to the lowest grade of uncivilized society, and a few families of Macoes. The epidemic fevers, which prevail here at the commencement of the rainy season, contributed greatly to the decay of the establishment. This distemper is ascribed to the violent heats, excessive humidity of the air, bad food, and, as the natives believe, to the noxious exhalations that rise from the bare rocks of the rapids. This last is a curious circumstance, and, as Humboldt remarks, is the more worthy of attention on account of its being connected with a fact that has been observed in several parts of the world, although it has not yet been sufficiently explained.

Among the cataracts and falls of the Orinoco, the granitic rocks, wherever they are periodically submersed, become smooth, and seem as if coated with black lead. The crust is only 0·3 of a line in thickness, and occurs chiefly on the quartzey parts of the stone, which is coarse-grained, and contains solitary crystals of hornblende. The same appearance is presented at the cataracts of Syene as well as those of the Congo. This black deposit, according to Mr Children's analysis, consists of oxide of iron and manganese, to which some experiments of Humboldt induced him to add carbon and supercarburetted iron. The phenomenon has hitherto been observed only in the torrid zone, in rivers that overflow periodically and are bounded by primitive rocks, and is supposed by our author to arise from the precipitation of substances chemically dissolved in the water, and not from an efflorescence of matters contained in the rocks themselves. The Indians and missionaries assert, that the exhalations from these rocks are unwholesome, and consider it dangerous to sleep on granite near the river; and our travellers, without entirely crediting this assertion, usually took care to avoid the black rocks at night. But the danger of reposing on them, Humboldt thinks, may rather be owing to the very great degree of warmth

CHAP. XVIII.

Mission station.

Cataracts of the Orinoco.

Singular phenomenon.

CHAP. XVIII. they retain during the night, which was found to be 96°8', while that of the air was 78°8'. In the day their temperature was 118°4', and the heat which they emitted was stifling.

Insalubrity
of climate.

Among the causes of the depopulation of the missions, Humboldt mentions the general insalubrity of the climate, bad nourishment, want of proper treatment in the diseases of children, and the practice of preventing pregnancy by the use of deleterious herbs. Among the savages of Guiana, when twins are produced one is always destroyed, from the idea that to bring more than one at a time into the world is to resemble rats, opossums, and the vilest animals, and that two children born at once cannot belong to the same father. When any physical deformity occurs in an infant, the father puts it to death, and those of a feeble constitution sometimes undergo the same fate, because the care which they require is disagreeable. "Such," says Humboldt, "is the simplicity of manners,—the boasted happiness of man, in the state of nature! He kills his son to escape the ridicule of having twins, or to avoid travelling more slowly,—in fact, to avoid a little inconvenience."

Destruction
of children.

Great
Cataracts.

The two great cataracts of the Orinoco are formed by the passage of the river across a chain of granitic mountains, constituting part of the Parime range. By the natives they are called Mapara and Quittuna; but the missionaries have denominated them the falls of Atures and Maypures, after the first tribes which they assembled in the nearest villages. They are only 41 miles distant from each other, and are not more than 345 miles west of the cordilleras of New Grenada. They divide the Christian establishments of Spanish Guiana into two unequal parts; those situated between the lower cataract, or that of Apures, and the mouth of the river, being called the missions of the Lower Orinoco, and those between the upper cataract and the mountains of Duida, being called the missions of the Upper Orinoco. The length of the lower section, including its sinuosities, is 897 miles, while that of the upper is 576 miles. The

Mission
stations.

navigation of the river extends from its mouth to the point where it meets the Anaveni near the lower cataract, although in the upper part of this division there are rapids which can be passed only in small boats. The principal danger, however, is that which arises from natural rafts, consisting of trees interwoven with lianas, and covered with aquatic plants carried down by the current. The cataracts are formed by bars stretching across the bed of the river, which forces its way through a break in the mountains; but beyond this rugged pass the course is again open for a length of more than 576 miles.

CHAP. XVIII
Dangers of
the navigation.

The scenery in the vicinity of the lower fall is described as exceedingly beautiful. To the west of Atures, a pyramidal mountain, the Peak of Uniana, rises from a plain to the height of nearly 3200 feet. The savannahs, which are covered with grasses and slender plants, though never inundated by the river, present a surprising luxuriance and diversity of vegetation. Piles of granitic blocks rise here and there, and at the margins of the plains occur deep valleys and ravines, the humid soil of which is covered with arums, heliconias, and lianas. The shelves of primitive rocks, scarcely elevated above the plain, are partially coated with lichens and mosses, together with succulent plants, and tufts of evergreen shrubs with shining leaves. On all sides the horizon is bounded by mountains, overgrown with forests of laurels, among which clusters of palms rise to the height of more than a hundred feet, their slender stems supporting tufts of feathery foliage. To the east of Atures other mountains appear, the ridge of which is composed of pointed cliffs rising like huge pillars above the trees. When these columnar masses are situated near the Orinoco, flamingoes, herons, and other wading birds, perch on their summits, and look like sentinels. In the vicinity of the cataracts, the moisture which is diffused in the air produces a perpetual verdure, and wherever soil has accumulated on the plains, it is occupied by the beautiful shrubs of the mountains.

Beauty of
the scenery.

CHAP. XVIII.

Rainy
season.

The rainy season had scarcely commenced, yet the vegetation displayed all the vigour and brilliancy which, on the coast, it assumes only towards the end of the rains. The old trunks were decorated with orchidæ, bannisterias, bignonias, arums, and other parasitic plants. Mimosas, figs, and laurels, were the prevailing trees in the woody spots; and in the vicinity of the cataract were groups of heliconias, bamboos, and palms.

Dikes of
rock.

Along a space of more than five miles, the bed of the Orinoco is traversed by numerous dikes of rock, forming natural dams, filled with islands of every form, some rocky and precipitous, while others resemble shoals. By these the river is broken up into torrents, which are ever dashing their spray against the rocks. They are all furnished with sylvan vegetation, and resembled a mass of palm-trees rising amidst the foam of the waters. The current is divided into a multitude of rapids, each endeavouring to force a passage through the narrows, and is every where engulfed in caverns; in one of which the travellers heard the water rolling at once over their heads and beneath their feet.

Passage of
the falls.

Notwithstanding the formidable aspect of this long succession of falls, the Indians pass many of them in their canoes. When ascending they swim on before, and after repeated efforts succeed in fixing a rope to a point of rock, and thus draw the canoe up the rapid. Sometimes it fills with water, and is not unfrequently dashed to pieces against the shelves; upon which the sailors again swim, though not without difficulty, through the whirlpools to the nearest island. When the bars are very high the vessels are taken ashore, and drawn upon rollers, made of the branches of trees, to a place where the river again becomes navigable. During the flood, however, this operation is seldom necessary.

Height of
the falls.

Although the rapids of the Orinoco form a long series of falls, the noise of which is heard at the distance of more than three miles, yet the rocks were found by Humboldt not to have a greater height than thirty feet perpendicular. He thinks it probable that a consider-

able part of the water is lost by passing into subterranean cavities, independently of that which disappears by being dispersed in the atmosphere. Numberless holes and sinuosities are formed in the crevices by the friction of the sand and quartz pebbles; but he does not consider that any great change is effected in the general form of the cataracts by the action of the water, the granite being too hard to be worn away to a great extent. The Indians assert that the stony barriers preserve the same aspect; but that the partial torrents into which the river divides itself are changed in their direction, and carry sometimes more sometimes less water towards one or other bank.

CHAP. XVIII.
Changes on
the river-bed.

When the rush of the cataracts is heard in the plain that surrounds the mission of Atures, one imagines he is near a coast skirted by reefs and breakers. The noise is thrice as loud by night as by day. This circumstance had struck the padre and the Indians, and Humboldt attributes it to the cessation of the sun's action, which is productive of numberless currents and undulations of the air, impeding the progress of sound by presenting spaces of different density.

Noise of the
cataracts.

The jaguars, which abound every where on the Orinoco, are so numerous here that they come into the village, and devour the pigs of the poor Indians. The missionary related a striking instance of the familiarity of these animals:—"Two Indian children, a boy and girl eight or nine years of age, were sitting among the grass, near the village of Atures, in the midst of a savannah. It was two in the afternoon when a jaguar issued from the forest and approached the children, gamboling around them; sometimes concealing itself among the long grass, and again springing forward, with his back curved and his head lowered, as is usual with our cats. The little boy was unaware of the danger in which he was placed, and became sensible of it only when the jaguar struck him on the head with one of his paws. The blows thus inflicted were at first slight, but gradually became ruder. The claws of the jaguar wounded the child, and blood

Number of
the jaguars.

Singular
sport.

CHAP. XVIII flowed with violence. The little girl then took up a branch of a tree and struck the animal, which fled before her. The Indians hearing the cries of the children, ran up and saw the jaguar, which bounded off without showing any disposition to defend itself." "What," asks Humboldt, "meant this fit of playfulness in an animal which, although not difficult to be tamed in our menageries, is always so ferocious and cruel in the state of freedom! If we chose to admit that, being sure of its prey, it played with the young Indian as the domestic cat plays with a bird, the wings of which have been clipped, how can we account for the forbearance of a large jaguar when pursued by a little girl! If the jaguar was not pressed by hunger, why should it have gone up to the children! There are mysteries in the affections and hatreds of animals. We have seen lions kill three or four dogs which were put into their cage, and instantly caress another which had the courage to seize the royal beast by the mane. Man is ignorant of the sources of these instincts. It would seem that weakness inspires more interest the more confiding it is."

Reflections of Humboldt.

American hogs.

The cattle introduced by the Jesuits had entirely disappeared; but the Indians rear the common pig and another kind peculiar to America, and known in Europe by the name of pecari. A third species of hog, the Apida, which is of a dark-brown colour, wanders in large herds composed of several hundreds. M. Bonpland, when upon a botanical excursion, saw a drove of these animals pass near him. It marched in a close body; the males before, and each sow accompanied by her young. The natives kill them with small lances tied to cords. At the mission they saw a monkey of a new species, which had been brought up in captivity, and which every day seized a pig in the court-yard, and remained upon it from morning to night, in all its wanderings in the savannahs. Here, for the first time, they heard of the hairy man of the woods, a large animal of the ape kind, which, according to report, carries off women, builds huts, and sometimes eats human flesh.

Father Gili gravely relates the history of a lady of San Carlos, who passed several years with one, which she left only because she and the children she had to him were tired of living far from the church and the sacraments. In all his travels in America, Humboldt found no traces of a large anthropomorphous monkey, although in several places, very distant from each other, he heard similar accounts of it.

CHAP. XVIII.
 Hairy man of
 the woods.

Flies of various kinds unceasingly tormented the travellers; mosquitoes and simulia by day, and zancudoes by night. The missionary, observing that the insects were more abundant in the lowest stratum of the atmosphere, had constructed near the church a small apartment supported upon palm-trunks, to which they retired in the evening to dry their plants and write their journals.* At Maypures the Indians leave the village at night, and sleep on the little islands in the midst of the cataracts, where the insects are less numerous. Humboldt gives an elaborate account of these creatures, of which, however, the most interesting particulars alone can be here extracted. In the missions of the Orinoco, when two persons meet in the morning the first questions are,—“How did you find the zancudoes during the night! How are we to-day for the mosquitoes?” The plague of these animals, however, is not so general in the torrid zone as is commonly believed.

Torment
 from flies.

Humboldt's
 account.

* A similar expedient was tried by a British officer who had joined the insurgents under Bolivar, 1818. “These insects,” (the mosquitoes), says he, “do not rise high in the air, but are generated and remain near the wet banks of the river. I found a tree in the neighbourhood, which I ascended nearly to its top with a cord. This I attached firmly to the branches, and then fixed it round me, so that I could not fall, but sit with safety, although not with much comfort. It was, however, with me here as with many in various situations in life—I could estimate the nature and extent of my pleasures and my difficulties merely by comparison; and, certainly, although the being tied to the top of a tree as a sleeping-place was not very agreeable, it was far preferable to being among swarms of hungry mosquitoes where I had previously lodged. I enjoyed several hours’ sleep, and awoke considerably refreshed.”—*Robinson's Journal of an Expedition up the Orinoco and Arawca.*

CHAP. XVIII. On the table-lands that have an elevation of more than 2558 feet, and in very dry plains at a distance from rivers, they are not more numerous than in Europe; but along the valleys, as well as in moist places on the coast, they continually harass the traveller; the lower stratum of air, to the height of fifteen or twenty feet, being filled with a cloud of venomous insects. It is a remarkable circumstance, that on the streams, the water of which is of a yellowish-brown colour, the tipulary flies do not make their appearance. Not less astonishing is the fact, that the different kinds do not associate together: but that at certain hours of the day distinct species, as the missionaries say, mount guard. From half after six in the morning till five in the afternoon the air is filled with mosquitoes, which are of the genus *Simulium*, and resemble a common fly. An hour before sunset small gnats, called tempraneroes, succeeded them, to disappear between six and seven; after which zancudoes, a species of gnat, with very long legs, come abroad and continue until near sunrise, when the former again take their turn. Persons born in the country, whether whites, mulattoes, negroes, or Indians, all suffer from the sting of these insects, although not so severely as recently-arrived Europeans.

Habits of
mosquitoes.

Different
species of
flies.

Renewed
voyage.

The travellers, after remaining two days in the vicinity of the cataract of Atures, proceeded on the 17th to rejoin their canoe, already conducted by eight Indians of the mission through the rapids, and reached it about eleven in the morning, accompanied by Father Zea, who had procured a small stock of provisions, consisting of plantains, cassava, and fowls. The river was now free from shoals; and after a few hours they passed the rapids of Garcita, and perceived numerous small holes, at an elevation of more than 190 feet above the level of the current, which appeared to have been caused by the erosion of the waters. The night was spent in the open air, on the left bank.

On the 18th they set out at three in the morning, and near five in the afternoon reached the Raudal des Gua-

hiboes, on the dike of which they landed while the Indians were drawing up the boat. The gneiss-rock exhibited circular holes, produced by the friction of pebbles, in one of which they prepared a beverage consisting of water, sugar, and the juice of acid fruits, for the purpose of allaying the thirst of the missionary, who was seized by a fever-fit; after which they had the pleasure of bathing in a quiet place in the midst of the cataracts. After an hour's delay, the boat having been got up, they re-embarked their instruments and provisions. The river was 1705 yards broad, and had to be crossed obliquely, at a part where the waters rushed with extreme rapidity towards the bar, over which they were precipitated. In the midst of this dangerous navigation they were overtaken by a thunder-storm accompanied by torrents of rain; and, after rowing twenty minutes, found that so far from having made progress they were approaching the fall. But, as the Indians redoubled their efforts, the danger was escaped, and the boat arrived at nightfall in the port of Maypures. The night was extremely dark, and the village was at a considerable distance; still, as the missionary caused copal-torches to be lighted, they proceeded. As the rain ceased the zancudoes reappeared, and the flambeaux being extinguished, they had to grope their way. One of their fellow-travellers, Don Nicolas Soto, slipped from a round trunk on which he attempted to cross a gully, but fortunately received no injury. To add to their distress, the pilot talked incessantly of venomous snakes, water-serpents, and tigers. On their arrival at the mission they found the inhabitants immersed in profound sleep, and nothing was heard but the cries of nocturnal birds and the distant roar of the cataract.

At the village of Maypures they remained three days, for the purpose of examining the neighbourhood. The cataract, called by the Indians Quittuna, is formed by an archipelago of islands, filling the bed of the river to the length of 6395 yards, and by dikes of rock which occasionally join them together. The largest of these

CHAP. XVIII
Raudal des
Guallboas.

Thunder-
storm and
rain.

Maypures.

CHAP. XVIII shelves or bars are at Purimarimi, Manimi, and the Salto de la Sardina, the last of which is about nine feet high. To obtain a full view of the falls, the travellers frequently ascended the eminence of Manimi, a granitic ridge rising from the savannah, to the north of the church. "When one attains the summit of the rock," says Humboldt, "he suddenly sees a sheet of foam a mile in extent. Enormous masses of rock, of an iron blackness, emerge from its bosom, some of a mammillar form, and grouped like basaltic hills; others resembling towers, castles, and ruins. Their dark colour contrasts with the silvery whiteness of the foam. Every rock and islet is covered with tufts of stately trees. From the base of these prominences, as far as the eye can reach, there hangs over the river a dense mist, through which the tops of majestic palms are seen to penetrate. At every hour of the day this sheet of foam presents a different aspect. Sometimes the mountain-isles and palms project their long shadows over it; sometimes the rays of the setting sun are refracted in the humid cloud that covers the cataract, when coloured arches form, vanish, and reappear by turns."

View of the falls.

Mountain of Manimi.

The mountain of Manimi forms the eastern limit of a plain, which presented the same appearance as that of Atures. Toward the west is a level space formerly occupied by the waters of the river, and exhibiting rocks similar to the islands of the cataracts. These masses are also crowned with palms; and one of them, called Keri, is celebrated in the country for a white spot, which Humboldt supposed to be a large nodule of quartz. In an islet amidst the rush of waters there is a similar spot. The Indians view them with a mysterious interest, believing they see in the former the image of the moon, and in the latter that of the sun.

Natives of the mission.

The inhabitants of the mission were Guahiboes and Macoes. In the time of the Jesuits the number was six hundred, but it had gradually fallen to less than sixty. They are represented as gentle, temperate, and cleanly. They cultivate plantains and cassava, and, like most of

the Indians of the Orinoco, prepare nourishing drinks from the fruits of palms and other plants. Some of them were occupied in manufacturing a coarse pottery. Cattle, and especially goats, had at one time multiplied considerably at Maypures; but at the period of Humboldt's visit none were to be seen in any mission of the Orinoco. Tame macaws were seen round the huts, and flying in the fields like pigeons. Their plumage being of the most vivid tints of purple, blue, and yellow, these birds are a great ornament to the Indian farmyards.

CHAP. XVIII
Manufacture
of pottery.

Round the village there grows a majestic tree of the genus *Unona*, with straight branches rising in the form of a pyramid. The infusion of the aromatic fruit is a powerful febrifuge, and is used as such in preference to the astringent bark of the *Cinchona* or *Bonplandia trifoliata*.

Unona tree.

The longitude of this place was found to be $68^{\circ} 17' 9''$, the latitude $5^{\circ} 13' 57''$, differing from the best maps then existing by half a degree of longitude and as much of latitude. The thermometer during the night indicated from 80° to 84° , and in the day 86° . The water of the river was 81.7° , and that of a spring 82° .

Having spent some days at the mission of Maypures, the travellers embarked at two in the afternoon in the canoe procured at the turtle island, which, although considerably damaged by the carelessness of the Indians, was judged sufficient for the long voyage they had yet to perform. Above the great cataracts they found themselves as it were in a new world. Toward the east, in the extreme distance, rose the great chain of the Cunavami mountains, one of the peaks of which, named Calitamini, reflects at sunset a reddish glare of light. After encountering one more rapid, they entered upon smooth water, and passed the night in a rocky island.

Change of
scenery.

On the 22d they set out at an early hour. The morning was damp but delicious, and not a breath of wind was felt; a perpetual calm reigning to the south

CHAP. XVIII.

Perpetual
calm.

of the cataracts, which Humboldt attributes to the windings of the rivers, the shelter of mountains, and the almost incessant rains. In the valley of the Amazon, on the contrary, a strong breeze rises every day at two in the afternoon, which, however, is felt only along the line of the current. It always moves against the stream, and by means of it a boat may go up the Amazon under sail a length of 2590 miles. The great salubrity of this district is probably owing to the gale. They passed the mouths of several streams, and admired the grandeur of the cerros of Sipapo, a branch of the cordillera of Parime, the aspect of which varied every hour of the day. At sunrise, the dense vegetation with which they are covered was tinged with a dark-green inclining to brown, while broad and deep shadows were projected over the neighbouring plain, forming a strong contrast with the vivid light diffused around. Toward noon the shadows disappeared, and the whole group was veiled in an azure vapour, which softened the outlines of the rocks, moderated the effects of light, and gave the landscape an aspect of calmness and repose. Landing at the mouth of the Rio Vichada to examine the vegetation, they found numberless small granitic rocks rising from the plain, and presenting the appearance of prisms, ruined columns, and towers. The forest was thin, and at the confluence of the two rivers, the rocks and even the soil were covered with mosses and lichens. M. Bonpland found several specimens of *Laurus cinnamomoides*, a very aromatic species of cinnamon, which, together with the American nutmeg, the pimento, and *Laurus pucheri*, Humboldt remarks, would have become important objects of trade, had not Europe, at the period when the New World was discovered, been already accustomed to the spices of India. The travellers rested at night on the bank of the Orinoco, at the mouth of the Zama. This river is one of those which are said to have black water, as it appears of a dark-brown or greenish-black; and here they entered the system of rivers to which the

Mouth of the
Rio Vichada.Cinnamon
and nutmeg
plants.

name of *Aguas Negras* is given. The colour is supposed to be owing to a solution of vegetable matter, and the Indians attribute it to the roots of sarsaparilla.

CHAP. XVIII.

—
Aguas
Negras.

At three in the morning of the 23d they continued their voyage, and passed the mouth of the Rio Mataveni. The banks were still skirted by forests, but the mountains on the east retired farther back. The traces left by the floods were not higher than eight feet. At the place where they passed the night, multitudes of bats issued from the crevices, and hovered around their hammocks. Next day a violent rain obliged them to set out at a very early hour. In the afternoon they landed at the Indian plantation of San Fernando, and after midnight arrived at the mission, where they were received with the kindest hospitality.

Mouth of the
Rio Mata-
veni.

The village of San Fernando de Atabapo is situated near the confluence of the Orinoco, the Atabapo, and the Guaviare ; the latter of which Humboldt thinks might with more propriety be considered the continuation of the Orinoco than a branch. The number of inhabitants did not exceed 226. The missionary had the title of president of the stations on the Orinoco, and superintended the twenty-six ecclesiastics settled on its banks as well as on those of the Rio Negro, Casiquiare, Atabapo, and Caura. The Indians were a little more civilized than the inmates of the other establishments, and cultivated cacao in small quantities, together with cassava and plantains. They were surrounded with good pasturage, but not more than seven or eight cows were to be seen. The most striking object in the neighbourhood was the pirijao palm, which has a thorny trunk more than sixty-four feet high, pinnated leaves, and clusters of fruit two or three inches in diameter, and of a purple colour. The fruit furnishes a farinaceous substance, of a colour resembling that of the yolk of an egg, which when boiled or roasted affords a very wholesome and agreeable aliment.

San Fernando
de Atabapo.

Indians.

On entering the Rio Atabapo the travellers found a great change in the scenery, the colour of the stream,

CHAP. XVIII. and the constitution of the atmosphere. The trees were of a different species; the mosquitoes had entirely disappeared; and the waters, instead of being turbid and loaded with earthy matter, were of a dark colour, clear, agreeable to the taste, and four degrees cooler. So great is their transparency, that the smallest fishes are distinguishable at the depth of twenty or thirty feet; and the bottom, which consists of white quartz sand, is usually visible. The banks covered with plants, among which rise numerous palms, are reflected by the surface of the river with a vividness almost as bright as that of the objects themselves. Above the mission no crocodiles occur, but their place is supplied by bavas and fresh-water dolphins. The chiguirens, howling-monkeys, and zamuro-vultures had disappeared, though jaguars were still seen, and the water-snakes were extremely numerous.

Slow progress.

On the 26th the travellers advanced only eight or ten miles, and passed the night on a rock near the Indian plantations of Guapasoso. At two in the morning they again set out, and continued to ascend the river. About noon they passed the granitic rock named Piedra del Tigre, and at the close of the day had great difficulty in finding a suitable place for sleeping, owing to the inundation of the banks. It rained hard from sunset, and as the missionary had a fit of tertian fever they re-embarked immediately after midnight. At dawn they landed to examine a gigantic ceiba-tree, which was nearly 128 feet in height, with a diameter of fifteen or sixteen feet. On the 29th the air was cooler, but loaded with vapours, and the current being strong they advanced slowly. It was night when they arrived at the mission of San Baltasar, where they lodged with a Catalan priest, a lively and agreeable person. The village was built with great regularity, and the plantations seemed better cultivated than elsewhere.

Gigantic ceiba-tree.

At a late hour in the morning they left his abode, and after ascending the Atabapo for five miles entered the Rio Temi. A granitic rock on the western bank of

the former river attracted their attention. It is called the CHAP. XVIII
 Piedra de la Guahiba or Piedra de la Madre, and commemorates one of those acts of oppression of which The Rio
 Europeans are guilty in all countries whenever they Guaviara.
 come into contact with savages. The missionary of San Fernando had led his people to the banks of the Rio Guaviara on a hostile excursion. In an Indian hut they found a Guahibo woman, with three children, occupied in preparing cassava-flour. She and her little ones attempted to escape, but were seized and carried away. The unhappy female repeatedly fled with her children Guahibo
 from the village, but was always traced by her Christian woman.
 countrymen. At length the friar, after causing her to be severely beaten, resolved to separate her from her family, and sent her up the Atabapo toward the missions of the Rio Negro. Ignorant of the fate intended for her, but judging by the direction of the sun that her persecutors were carrying her far from her native country, she burst her fetters, leaped from the boat, and swam to the left bank of the river. She landed on a rock; but the president of the establishment ordered the Indians to row to the shore and lay hands on her. She was brought back in the evening, stretched upon the bare stone (the Piedra de la Madre), scourged with straps of manatee leather, which are the ordinary whips of the country, and then dragged to the mission of Javita, her hands bound behind her back. It was the rainy season, the night was excessively dark, forests believed to be impenetrable stretched from that station to San Fernando over an extent of 86 miles, and the only communication between these places was by the river; yet the Guahibo mother, breaking her bonds, Maternal
 and eluding the vigilance of her guards, escaped under affection.
 night, and on the fourth morning was seen at the village, hovering around the hut which contained her children. On this journey she must have undergone hardships from which the most robust man would have shrunk; was forced to live upon ants, to swim numerous streams, and to make her way through thickets and

CHAP. XVIII thorny lianas. And the reward of all this courage and devotion was—her removal to one of the missions of the Upper Orinoco, where, despairing of ever seeing her beloved children, and refusing all kind of nourishment, she died, a victim to the bigotry and barbarity of wretches blasphemously calling themselves the ministers of a religion which inculcates universal benevolence.

Barbarity
of the
missionaries

Rio Temi.

Above the mouth of the Guasucavi the travellers entered the Rio Temi, which runs from south to north. The ground was flat and covered with trees, over which rose the pirijao palm with its clusters of peach-like fruits, and the *Mauritia aculeata*, with fan-shaped leaves pointing downwards, and marked with concentric circles blue and green. Wherever the river forms sinuosities the forest is flooded to a great extent; and, to shorten the route, the boat frequently pushed through the woods along open avenues of water four or five feet broad. An Indian furnished with a large knife stood at the bow continually cutting the branches which obstructed the passage. In the thickest part of it a shoal of fresh-water dolphins issued from beneath the trees and surrounded the vessel. At five in the evening the travellers, after sticking for some time between two trunks, and experiencing other difficulties, regained the proper channel, and passed the night near one of the columnar masses of granite which occasionally protrude from the level surface.

Sailing
through the
forest.

Setting out before daybreak, they remained in the bed of the river till sunrise, when, to avoid the force of the current, they again entered the inundated forest; and soon arriving at the junction of the Temi with the Tuamini, they followed the latter toward the southwest. At eleven they reached San Antonio de Javita, where they had the pleasure of finding a very intelligent and agreeable monk: though they were obliged to remain nearly a week, while the boat was carried by land to the Rio Negro. For two days the travellers had felt an extraordinary irritation on the joints of the fingers and on the back of the hands, which the mission-

ary informed them was caused by insects. Nothing could be distinguished with a lens but parallel streaks of a whitish colour, the form of which has obtained for these animalculæ the name of *aradores*, or ploughmen. A mulatto woman engaged to extirpate them one by one, and digging with a small bit of pointed wood, at length succeeded in extracting a little round bag; but Humboldt did not possess sufficient patience to wait for relief from so tedious an operation. Next day, however, an Indian effected a radical cure by means of the infusion of bark stripped from a certain shrub.

CHAP. XVIII.
Aradores.

In 1755, before the expedition to the boundaries, the country between the missions of Javita and San Baltasar was dependent on Brazil, and the Portuguese had advanced from the Rio Negro as far as the banks of the Temi. An Indian chief named Javita, one of their auxiliaries, pushed his hostile excursions to a distance of more than 345 miles; and, being furnished with a patent for drawing the natives from the forest "for the conquest of souls," did not fail to make use of it for selling slaves to his allies. When Solano, one of the leaders of the expedition just described, arrived at San Fernando de Atabapo, he seized the adventurer, and by treating him with gentleness gained him over to the interests of the Spaniards. He was still living when the travellers proceeded to the Rio Negro; and, as he attended them in all their botanical excursions, they obtained much information from him. He assured them, that he had seen almost all the Indian tribes which inhabit the vast countries between the Upper Orinoco, the Rio Negro, the Irinida, and the Jupura, devour human flesh. Their cannibalism he considered as the effect of a system of revenge, as they eat only enemies who are made prisoners in battle.

Slave trade.

Javita.

The climate of the mission of San Antonio de Javita is so rainy that the sun and stars are seldom to be seen, and the padre informed the travellers that it sometimes rained without intermission for four or five months. The water that fell in five hours on the first of May,

Rainy
climate.

CHAP. XVIII. Humboldt found to be 21 lines in height, and on the 3d of May he collected 14 lines in three hours; whereas at Paris there fall only 28 or 30 lines in as many weeks. The temperature is lower than at Maypures, but higher than on the Rio Negro; the thermometer standing at 79° or 80·6° by day, and at 69·8° by night.

Indian boats. The Indians of the mission amounted only to 160. Some of them were employed in the construction of boats, which are formed of the trunks of a species of laurel (*Ocotea cymbarum*), hollowed by means of fire and the axe. These trees attain a height of more than a hundred feet, and have a yellow resinous wood which emits an agreeable odour. The forest between Javita and Pimichin affords an immense quantity of gigantic timber, as tall occasionally as 106 or 117 feet; but as the trees give out branches only towards the summit, the travellers were disappointed, amid so great a profusion of unknown species, in not being able to procure the leaves and flowers. Besides, as it rained incessantly so long a time, M. Bonpland lost the greater part of his dried specimens. Although no pines or firs occur in these woods, balsams, resins, and aromatic gums, are abundantly furnished by many other trees, and are collected as objects of trade by the people of Javita.

Gum of the Hevea tree. At the mission of San Baltasar they had seen the natives preparing a kind of elastic gum, which they said was found under ground; and in the forests at Javita, the old Indian who accompanied them showed that it was obtained by digging several feet deep among the roots of two particular trees, the *Hevea* of Aublet and one with pinnate leaves. This substance, which bears the name of dapicho, is white, corky, and brittle, with a laminated structure and undulating edges; but on being roasted it assumes a black colour, and acquires the properties of caoutchouc.

Native hordes. The natives of these countries live in hordes of forty or fifty, and unite under a common chief only when they wage war with their neighbours. As the different tribes speak different languages, they have little com-

munication. They cultivate cassava, plantains, and sometimes maize ; but shift from place to place, so that they entirely lose the advantages resulting in other countries from agricultural habits. They have two great objects of worship,—the good principle, Cachimana, who regulates the seasons and favours the harvests ; and the evil principle, Jolokiamo, less powerful, but more active and artful. They have no idols ; but the botuto, or sacred trumpet, is an object of veneration, the initiation into the mysteries of which requires pure manners and a single life. Women are not permitted to see it, and are excluded from all the ceremonies of this religion.

CHAP. XVIII.
Cultivation.

It took the Indians more than four days to drag the boat upon rollers to the Rio Pimichin. One of them, a tall strong man, was bitten by a snake, and was brought to the mission in a very alarming condition. He had dropped down senseless, and was afterwards seized with nausea, vertigo, and a determination of blood to the head, but was cured by an infusion of raiz de mato ; respecting the plant furnishing which, Humboldt could obtain no satisfactory information, although he supposes it to be of the family of Apocynæ. In the hut of this individual he observed balls of an earthy and impure salt, two or three inches in diameter. It is obtained by reducing to ashes the spadix and fruit of a palm-tree, and consists of muriate of potash and soda, caustic lime, and other ingredients. The Indians dissolve a few grains in water, which they drop on their food.

Bite of a
snake.

Cura.

On the 5th May the travellers set off on foot to follow their canoe. They had to ford numerous streams, the passage of which was somewhat dangerous on account of the number of snakes in the marshes. After passing through dense forests of lofty trees, among which they noted several new species of coffee and other plants, they arrived toward evening at a small farm on the Pimichin, where they passed the night in a deserted hut, not without apprehension of being bitten by serpents, as they were obliged to lie on the floor. Before they took possession of this shed their attendants killed two great

Dangerous
route.

CHAP. XVIII. **Mapanare snakes, and in the morning a large viper was found beneath the jaguar-skin on which one of them had slept. This species of serpent is white on the belly, spotted with brown and black on the back, and grows to the length of four or five feet. Humboldt remarks, that if vipers and rattlesnakes had such a disposition for offence as is usually supposed, the human race could not have resisted them in some parts of America.**

Snakes and
vipers.

Rio Negro.

Embarking at sunrise they proceeded down the Pimichin, which is celebrated for the number of its windings. It is navigable during the whole year, and has only one rapid. In four hours and a half they entered the Rio Negro. "The morning," says Humboldt, "was cool and beautiful; we had been confined thirty-six days in a narrow canoe, so unsteady that it would have been upset by any one rising imprudently from his seat, without warning the rowers to preserve its balance by leaning to the opposite side. We had suffered severely from the stings of insects, but we had withstood the insalubrity of the climate; we had passed without accident the numerous falls and bars that impede the navigation of the rivers, and often render it more dangerous than long voyages by sea.

Satisfaction
of Humboldt.

"After all that we had endured, I may be allowed to mention the satisfaction which we felt in having reached the tributaries of the Amazon,—in having passed the isthmus which separates two great systems of rivers,—and in having attained a certainty of fulfilling the most important object of our journey,—that of determining by astronomical observations the course of that arm of the Orinoco which joins the Rio Negro, and whose existence had been alternately proved and denied for half a century. In these inland regions of the New Continent we almost accustom ourselves to consider man as inessential to the order of nature. The earth is overloaded with plants, of which nothing impedes the development. An immense layer of mould evinces the uninterrupted action of the organic powers. The crocodiles and boas are masters of the river; the jaguar, pecari, dante, and

monkeys of numerous species, traverse the forest without fear and without danger, residing there as in an ancient heritage. On the ocean and on the sands of Africa, we with difficulty reconcile ourselves to the disappearance of man; but here his absence, in a fertile country clothed with perpetual verdure, produces a strange and melancholy feeling.”

CHAP. XVIII.
Number
of wild
animals.

The Rio Negro, which flows eastward into the Amazon, was for ages considered of great political importance by the Spanish government, as it would have furnished to the Portuguese an easy introduction into the missions of Guiana. The jealousies of these rival nations, the ignorance and diversified languages of the Indians, the difficulty of penetrating into these inland regions, and other causes, rendered the knowledge of the sources, as well as the tributaries of the Negro and Orinoco, extremely defective. To endeavour to throw some light on this geographical point, and in particular to determine the course of that branch of the Orinoco which joins the Rio Negro, was the great object of Humboldt's journey. This last, or Black River, is so named on account of the dark colour of its waters, which are of an amber hue wherever it is shallow, and dark-brown wherever the depth is great. After entering it by the Pimichin, and passing the rapid at the confluence of the two streams, the travellers soon reached the mission of Maroa, containing 150 Indians, where they purchased some fine toucans. Passing the station of Tomo they visited that of Davipe, where they were received by the missionary with great hospitality. Here they bought some fowls and a pig, which interested their servants so much that they pressed them to depart, in order to reach the island of Dapa where the animal might be roasted. They arrived at sunset, and found some cultivated ground and an Indian hut. Four natives were seated round a fire eating a kind of paste, consisting of large ants, of which several bags were suspended over the fire. There were more than fourteen persons in this small cabin, lying naked in the hammocks placed above each other.

Importance
of the Rio
Negro.

Object of
Humboldt's
journey.

Davipe
station.

CHAP. XVIII. received Father Zea with great joy, and two young women prepared cassava-cakes; after which the travellers retired to rest. The family slept only till two in the morning, when they began to converse in their hammocks. This custom of being awake four or five hours before sunrise Humboldt found to be general among the people of Guiana; and hence, when an attempt is made to surprise them, the first part of the night is chosen for the purpose.

The Casiquiare.

Proceeding down the Rio Negro they passed the mouth of the Casiquiare, the river by which a communication is effected between the former and the Orinoco; and towards evening reached the mission of San Carlos del Rio Negro, with the commander of which they lodged. The military establishment of this frontier-post consisted of seventeen soldiers, ten of whom were detached for the security of the neighbouring stations. The voyage from the mouth of the Rio Negro to Grand Para occupying only twenty or twenty-five days, it would not have taken much more time to have gone down the Amazon to the coast of Brazil, than to return by the Casiquiare and Orinoco to that of Caraccas; but our travellers were informed that it was difficult to pass from the Spanish to the Portuguese settlements; and it was well for them that they declined this route, for they afterwards learned that instructions had been issued to seize and convey them to Lisbon. This project, however, was not countenanced by the government at home, who, when informed of the zeal of its subaltern agents, gave instant orders that the philosophers should not be disturbed in their pursuits.

Extent of voyage.

Indian amulets.

Among the Indians of the Rio Negro they found some of those green pebbles known by the name of Amazon-stones, and which are worn as amulets. The form usually given to them is that of the Persepolitan cylinders longitudinally perforated. These hard substances denote a degree of civilisation superior to that of the present inhabitants, who, so far from being able to cut them, imagine that they are naturally soft when taken

out of the earth, and harden after they have been moulded by the hand. They were found to be jade or saussurite, approaching to compact felspar, of a colour passing from apple to emerald green, translucent on the edges, and taking a fine polish; but the substance usually called Amazon-stone in Europe is different, being a common felspar of a similar colour, coming from the Uralian Mountains and Lake Onega, in Russia.

CHAP. XVIII.

Mineralo-
gical cha-
racter.

Connected with this mineral are the warlike women, whom the travellers of the sixteenth century named the Amazons of the New World; and regarding whom Humboldt found no satisfactory accounts, although he is disposed to believe that their existence was not merely imaginary.

Amazons.

The travellers passed three days at San Carlos, watching the greater part of each night, in the hope of seizing the moment of the passage of some star over the meridian; but the sky was continually obscured by vapours. On the 10th May they embarked a little before sunrise to go up the Rio Negro. The morning was fine, but as the heat increased the firmament became darkened. Passing between the islands of Zaruma and Mibita, covered with dense vegetation, and ascending the rapids of the Piedra de Unumane, they entered the Casiquiare at the distance of $9\frac{1}{2}$ miles from the fort of San Carlos. The rock at the rapids was granite, traversed by numerous veins of quartz several inches broad. The night was spent at the mission of San Francisco Solano, on the left bank of the Casiquiare. The Indians were of two nations, the Pacimonaes and Cheruvichahenas; and from the latter the travellers endeavoured to obtain some information respecting the upper part and sources of the Rio Negro, but without success. In one of the huts of the former tribe they purchased two large birds, a toucan and a macaw, to add to the already considerable stock which they possessed. Most of the animals were confined in small cages, while others ran at liberty all over the boat. At the approach of rain, the macaws uttered frightful screams, the toucan was desirous of gaining the shore in

San Carlos.

Entrance of
the Casi-
quiara.

Birds.

CHAP. XVIII.

Varied
habits.

order to fish, and the little monkeys went in search of Father Zea to obtain shelter in his large sleeves. At night the leathern case containing their provisions was placed in the centre; then the instruments and cages; around which were suspended the hammocks of the travellers; and beyond them the Indians slept, protected by a circle of fires to keep off the jaguars.

Longitude
and latitude.

On the 11th they left the mission of San Francisco Solano at a late hour to make a short day's journey, for the vapours had begun to break up, and the travellers were unwilling to go far from the mouth of the Casiquiare without determining the longitude and latitude. This they had an opportunity of doing at night in the neighbourhood of a solitary granite rock, the Piedra di Culimacari, which they found to be in lat. $2^{\circ} 0' 42''$ north, and long. $67^{\circ} 13' 26''$ west. The determination was of great importance in a geographical and political point of view, for the greatest errors existed in maps, and the equator had been considered as the boundary between the Spanish and Portuguese possessions.

Rock of
Culimacari.

Leaving the Rock of Culimacari at half after one in the morning, they proceeded against the current, which was very rapid. The waters of the Casiquiare are white, and the mosquitoes again commenced their invasions, becoming more numerous as the boat receded from the black stream of the Rio Negro. In the whole course of the Casiquiare they did not find in the Christian settlements a population of 200 individuals, and the free Indians have retired from its banks. During a great part of the year the natives subsist on ants. At the mission of Mandavaca, which they reached in the evening, they found a monk who had spent twenty years in the country, and whose legs were so spotted by the stings of insects that the whiteness of the skin could scarcely be perceived. He complained of his solitude, and the sad necessity which often compelled him to leave the most atrocious crimes unpunished. An indigenous alcaide, or overseer, had a few years before eaten one of his wives, after fattening her by good feeding. "You

Solitary
monk.

cannot imagine," said the missionary, "all the perversity of this Indian family. You receive men of a new tribe into the village; they appear to be good, mild, and industrious; but suffer them to take part in an incursion to bring in the natives, and you can scarcely prevent them from murdering all they meet, and hiding some portions of the dead bodies." The travellers had in their canoe a fugitive Indian from the Guaisia, who in a few weeks had become sufficiently civilized to be very useful. As he was mild and intelligent, they had some desire of taking him into their service; but discovering that his anthropophagous propensities remained they gave up the idea. He told them that "his relations (the people of his tribe) preferred the inside of the hands in man, as in bears," accompanying the assertion with gestures of savage joy.

CHAP. XVIII.

Character
of the
Indians.

Cannibalism.

Although the Indians of the Casiquiare readily return to their barbarous habits, they manifest, while in the missions, intelligence, industry, and a great facility in learning the Spanish tongue. As the villages are usually inhabited by three or four tribes who do not understand each other, the language of their instructor affords a general means of communication. The soil on the Casiquiare is of excellent quality. Rice, beans, cotton, sugar, and indigo, thrive wherever they have been tried; but the humidity of the air, and the swarms of insects, oppose almost insuperable obstacles to cultivation. Immense bands of white ants destroy every thing that comes in their way; insomuch, that when a missionary would cultivate salad, or any European culinary vegetable, he fills an old boat with soil, and having sown the seeds suspends it with cords, or elevates it on posts.

Intelligence
and industry.

From the 14th to the 21st the travellers continued to ascend the Casiquiare, which flowed with considerable rapidity, having a breadth of 426 yards, and bordered by two enormous walls of trees hung with lianas. No openings could be discovered in these fences; and at night the Indians had to cut a small spot with their hatchets to make room enough for their beds, it being

Ascent of
the Casi-
quiare.

CHAP. XVIII. impossible to remain in the canoe on account of the mosquitoes and heavy rains. Great difficulty was experienced in finding wood to make a fire, the branches being so full of sap that they would scarcely burn. On shore the pothoses, arums, and lianas, furnished so thick a covering, that although it rained violently they were completely sheltered. At their last resting-place on the Casiquiare, the jaguars carried off their great dog while they slept.

Difficulties
on shore.

Channel of
the Orinoco.

On the 21st May they again entered the channel of the Orinoco, three leagues below the mission of Esmeralda. Here the scenery wore a very imposing aspect, lofty granitic mountains rising on the northern bank. The celebrated bifurcation of the river takes place in this manner: The stream, issuing from among the mountains, reaches the opening of a valley or depression of the ground which terminates at the Rio Negro, and divides into two branches. The principal branch continues its course toward the west-north-west, turning round the group of the mountains of Parime, while the other flows off southward and joins the Rio Negro. By this latter branch our travellers ascended from the river just mentioned, and again entered the Orinoco, four weeks after they had left it near the mouth of the Guaviare. They had still a voyage of 863 miles to perform before reaching Angostura.

CHAPTER XIX.

Route from Esmeralda to Angostura.

- Mission of Esmeralda—Curare Poison—Indians—Duida Mountain—Descent of the Orinoco—Cave of Atarupe—Raudalito of Carucari—Mission of Uruana—Character of the Otomacs—Clay eaten by the Natives—Arrival at Angostura—The Travelers attacked by Fever—Ferocity of the Crocodiles.

OPPOSITE the point where the division of the river takes place, there rises in the form of an amphitheatre a group of granitic mountains, of which the principal one bears the name of Duida. It is about 8500 feet high; and being perpendicular on the south and west, bare and stony on the summit, and clothed on its less steep declivities with vast forests, presents a magnificent spectacle. At the foot of this huge mass is placed the most solitary and remote Christian settlement on the Upper Orinoco, —the mission of Esmeralda, containing eighty inhabitants. It is surrounded by a beautiful plain, covered with grasses of various species, pine-apples, and clumps of *Mauritia* palm, and watered by limpid rills.

There was no monk at the village; but the travellers were received with kindness by an old officer, who, taking them for Catalonian shopkeepers, admired their simplicity when he saw the bundles of paper in which their plants were preserved, and which he supposed they intended for sale. Notwithstanding the smallness of the mission, three Indian languages were spoken in it; and among the inhabitants were some Zamboes, mulattoes,

CHAP. XIX.
Duida
mountain.

Hospitable
reception.

CHAP. XIX. and copper-coloured people. A mineralogical error gave celebrity to Esmeralda, the rock-crystals and chloritic quartzes of Duida having been mistaken for diamonds and emeralds. The converts live in great poverty, and their misery is augmented by prodigious swarms of mosquitoes. Yet the situation of the establishment is exceedingly picturesque; the surrounding country is possessed of great fertility; and plantains, indigo, sugar, and cacao, might be produced in abundance.

Curare
poison.

This village is the most celebrated spot on the Orinoco for the manufacture of the curare, a very active poison employed in war and in the chase, as well as a remedy for gastric obstructions. Erroneous ideas had been entertained of this substance; but our travellers had an opportunity of seeing it prepared. When they arrived at Esmeralda, most of the Indians had just finished an excursion to gather juvias or the fruit of the bertholletia, and the liana which yields the curare. Their return was celebrated by a festival, which lasted several days, during which they were in a state of intoxication. One less drunk than the rest was employed in preparing the poison. He was the chemist of the place, and boasted of his skill, extolling the composition as superior to any thing that could be made in Europe. The liana which yields it is named bejuco, and appeared to be of the Strychnos family. The branches are scraped with a knife, and the bark that comes off is bruised, and reduced to very thin filaments on the stone employed for grinding cassava. A cold infusion is prepared by pouring water on this fibrous mass, in a funnel made of a plantain-leaf rolled up in the form of a cone, and placed in another somewhat stronger made of palm-leaves, the whole supported by a slight framework. A yellowish fluid filters through the apparatus. It is the venomous liquor; which, however, acquires strength only when concentrated by evaporation in a large earthen pot. To give it consistence, it is mixed with a glutinous vegetable juice, obtained from a tree

Indian
festival.

Mode of
preparing
curare.

named kiracaguera. At the moment when this addition is made to the fluid, now kept in a state of ebullition, the whole blackens, and coagulates into a substance resembling tar or thick syrup. The curare may be tasted without danger; for, like the venom of serpents, it only acts when introduced directly into the blood, and the Indians consider it an excellent stomachic. It is universally employed by them in hunting, the tips of their arrows being covered with it; and the usual mode of killing domestic fowls is to scratch the skin with one of these infected weapons. Other species of vegetable poison are manufactured in various parts of Guiana.

CHAP. XIX.

Nature of its
poison.

After seeing this composition prepared, the philosophers accompanied the artist to the festival of the juvias. In the hut where the revellers were assembled, large roasted monkeys blackened by smoke were ranged against the wall. Humboldt imagines that the habit of eating animals so much resembling man has in some degree contributed to diminish the horror of anthropophagy among savages. Apes when thus cooked, and especially such as have a very round head, bear a hideous likeness to a child; and for this reason such Europeans as are obliged to feed upon them separate the head and hands before the dish is presented at their tables. The flesh is very lean and dry.

Festival of
the juvias.

Among the articles brought by the Indians from their expedition were various interesting vegetable productions; fruits of different species, reeds upwards of fifteen feet long, perfectly straight and free of knots, and bark used for making shirts. The women were employed in serving the men with the food already mentioned, fermented liquors, and palm-cabbage, but were not permitted to join in the festivities. Among all the tribes of the Orinoco the females live in a sort of slavery, almost the whole labour devolving upon them. Polygamy is frequently practised, and on the other hand a kind of polyandry is established in places where the fair sex are less numerous. When a native who has several wives becomes a Christian, the missionaries

Interesting
vegetable
productions.

CHAP. XIX. — compel him to choose her whom he prefers and to dismiss the others.

Summit of
the Duida.

The summit of Duida is so steep that no person has ever ascended it. At the beginning and end of the rainy season, small flames, which appear to shift, are seen upon it. On this account the mountain has been called a volcano, which, however, it is not. The granite whereof it is composed is full of veins, some of which being partly open, gaseous and inflammable vapours may pass through them; for it is not probable that the flames are caused by lightning, the humidity of the climate being such that plants do not readily take fire.

Dwarf
Indians.

The travellers had an opportunity of seeing at Esmeralda some of the dwarf and fair Indians, that ancient traditions had mentioned as living near the sources of the Orinoco. The Guaicas, or diminutive class, whom they measured, were in general from 4 feet 10½ to 4 feet 11½ inches in height; and it was said that the whole tribe was of the same stature. The Guahariboes, or fair variety, were similar to the others in form and features, and differed only in having the skin of a lighter tint.

Departure
from Esmer-
alda.

On the 23d May the travellers left the mission of Esmeralda in a state of languor and weakness caused by the torment of insects, bad nourishment, and a long voyage performed in a narrow and damp boat. They had not attempted to ascend the Orinoco towards its sources, as the country above that station was inhabited by hostile Indians; so that of the two geographical problems connected with the river,—the position of its sources and the nature of its communication with the Rio Negro,—they had been obliged to content themselves with the solution of the latter. When they embarked they were surrounded by the mulattoes and others who considered themselves Spaniards, and who entreated them to solicit from the governor of Angostura their return to the Llanos, or at least their removal to the missions of the Rio Negro. Humboldt pleaded the cause of these proscribed men at a subsequent period;

but his efforts were fruitless. The weather was very stormy, and the summit of Duida was enveloped in clouds; but the thunders which rolled there did not disturb the plains. Nor did they, generally speaking, observe in the valley of the Orinoco those violent electric explosions which almost every night, during the rainy season, alarm the traveller along the Rio Magdalena. After four hours' navigation in descending the stream, they arrived at the bifurcation, and reposed on the same beach of the Casiquiare, where a few days before their dog had been carried off by the jaguars. The cries of these animals were again heard through the whole night. The black tiger also occurs in these districts. It is celebrated for its strength and ferocity, and appears to be larger than the other, of which, however, it is probably a variety.

CHAP. XII

Stormy
weather.

Leaving their resting-place before sunrise, and sailing with the current, they passed the mouths of the Cunucunumo, Guanami, and Puruname. The country was entirely desert, although rude figures representing the sun, the moon, and different animals, are to be seen on the granite rocks; attesting the former existence of a people more civilized than any that they had seen.

Passage
down the
river.

On the 27th May they reached the mission of San Fernando de Atabapo, where they had lodged a month before on their ascent toward the Rio Negro. The president had allowed himself to become very uneasy respecting the object of their journey; and requested Humboldt to leave a writing in his hands, bearing testimony to the good order that prevailed in the Christian settlements on the Orinoco, and the mildness with which the natives were treated. This, however, he declined. From this point they retraced their former route, and passed the cataracts. On the 31st they landed before sunset at the Puerto de la Expedicion, for the purpose of visiting the cave of Atarupe, which is the sepulchre of an extinct nation.

San Fer-
nando de
Atabapo.

"We climbed," says Humboldt, "with difficulty and not without danger, a steep rock of granite, entirely

CHAP. XIX.

Ascent to a
sepulchral
cave.

Remarkable
view.

Masses of
granite.

destitute of soil. It would have been almost impossible to fix the foot on this smooth and highly inclined surface, had not large crystals of felspar, which had resisted decomposition, projected from the rock so as to present points of support. Scarcely had we reached the summit of the mountain when we were struck with astonishment at the extraordinary appearance of the surrounding country: The foamy bed of the waters was filled with an archipelago of islands covered with palms. Toward the west, on the left bank of the Orinoco, extended the savannahs of the Meta and Casanare, like a sea of verdure, the misty horizon of which was illuminated by the rays of the setting sun. The mighty orb, like a globe of fire suspended over the plain, and the solitary peak of Uniana, which appeared more lofty from being wrapped in vapours that softened its outlines, contributed to impress a character of sublimity upon the scene. We looked down into a deep valley enclosed on every side. Birds of prey and goatsuckers winged their solitary way in this inaccessible circus. We found pleasure in following their fleeting shadows as they glided slowly over the flanks of the rock.

“A narrow ridge led us towards a neighbouring mountain, the rounded summit of which supported enormous blocks of granite. These masses are more than 40 or 50 feet in diameter, and present a form so perfectly spherical, that, as they seem to touch the ground only by a small number of points, it might be supposed that the slightest shock of an earthquake would roll them into the abyss. I do not remember to have seen any where else a similar phenomenon amid the decompositions of granitic deposits. If the balls rested upon a rock of a different nature, as in the case with the blocks of Jura, it might be supposed that they had been rounded by the action of water, or projected by the force of an elastic fluid; but their position, on the summit of a hill of the same nature, renders it more probable that they owe their origin to a gradual decomposition of the rock.

“ The most remote part of the valley is covered by a dense forest. In this shady and solitary place, on the declivity of a steep mountain, opens the cave of Ataruipe. It is less a cave than a projecting rock, in which the waters have scooped a great hollow, when, in the ancient revolutions of our planet, they had reached to that height. In this tomb of a whole extinct tribe we soon counted nearly 600 skeletons in good preservation, and arranged so regularly that it would have been difficult to make an error in numbering them. Each skeleton rests upon a kind of basket formed of the petioles of palms. These baskets, which the natives call *mapires*, have the form of a square bag. Their size is proportional to the age of the dead; and there are even some for infants which had died at the moment of birth. We saw them from ten inches and a half to three feet six inches and a half in length. All the skeletons are bent, and so entire that not a rib or a bone of the fingers or toes is wanting. The bones have been prepared in three different ways,—whitened in the air and sun, dyed red with *onoto*, a colouring matter obtained from the *Bixa orellana*; or, like mummies, covered with odorous resins, and enveloped in leaves of heliconia and banana. The Indians related to us, that the corpse is first placed in the humid earth, that the flesh may be consumed by degrees. Some months after it is taken out, and the flesh that remains on the bones is scraped off with sharp stones. Several tribes of Guiana still follow this practice. Near the *mapires* or baskets there were vases of half-burnt clay, which appeared to contain the bones of the same family. The largest of these vases or funereal urns are three feet two inches high, and four feet six inches long. They are of a greenish-gray colour, and have an oval form not unpleasant to the eye. The handles are made in the form of crocodiles or serpents, and the edge is encircled by meanders, labyrinths, and grecques, with narrow lines variously combined. These paintings are seen in all countries, among nations placed at the

CHAP. XIX.

Cave of
Ataruipe.

Skeletons.

Mummies.

CHAP. XIX.
Ornamental
pottery.

greatest distances from each other, and the most different in respect to civilisation. The inhabitants of the little mission of Maypures execute them at the present day on their most common pottery. They adorn the shields of the Otaheitans, the fishing-instruments of the Esquimaux, the walls of the Mexican palace of Mitla, and the vases of Magna Græcia.

Crania.

“ We opened, to the great concern of our guides, several mapires, for the purpose of attentively examining the form of the skulls. They all presented the characters of the American race,—two or three only approached the Caucasian form. We took several skulls, the skeleton of a child of six or seven years, and those of two full-grown men, of the nation of the Atures. All these bones, some painted red, others covered with odorous resins, were placed in the mapires or baskets already described. They formed nearly the whole lading of a mule ; and, as we were aware of the superstitious aversion which the natives show towards dead bodies, after they have given them burial, we carefully covered the baskets with new mats. Unfortunately for us, the penetration of the Indians, and the extreme delicacy of their organs of smell, rendered our precautions useless. Wherever we stopped,—in the Carib missions, in the midst of the Llanos, between Angostura and New Barcelona,—the natives collected around our mules to admire the monkeys which we had brought from the Orinoco. These good people had scarcely touched our baggage when they predicted the approaching death of the beast of burden ‘ that carried the dead.’ In vain we told them that they were deceived in their conjectures, that the panniers contained bones of crocodiles and lamantins ; they persisted in repeating, that they smelt the resin which surrounded the skeletons, and that ‘ they were some of their old relatives.’

Acuteness of
the Indians.

“ We departed in silence from the cave of Ataruipe. It was one of those calm and serene nights which are so common in the torrid zone. The stars shone with a mild and planetary light ; their scintillation was

scarcely perceptible at the horizon, which seemed illuminated by the great nebulae of the southern hemisphere. Multitudes of insects diffused a reddish light over the air. The ground, profusely covered with plants, shone with those living and moving lights as if the stars of the firmament had fallen upon the savannah. On leaving the cave, we repeatedly stopped to admire the beauty of this extraordinary place. The scented vanilla and festoons of bignonix decorated its entrance; while the summit of the overhanging hill was crowned by arrowy palm-trees that waved murmuring in the air."

CHAP. XIX.
Night-scene.

Similar caves are said to exist to the north of the cataracts; but the tombs of the Indians of the Orinoco have not been sufficiently examined, because they do not, like those of Peru, contain treasures.

Tombs of the
Indians.

The travellers staid at the mission of Atures only so long as was necessary for the passage of their canoe through the great falls. The priest, Bernardo Zea, who had accompanied them to the Rio Negro, remained behind. His ague had not been removed; but its attacks had become an habitual evil, to which he now paid little attention. Fevers of a more destructive kind prevailed in the establishment, insomuch that the greater part of the inmates were confined to their hammocks. Again embarked on the Orinoco the travellers ventured to descend the lower half of the rapids of Atures, landing here and there to climb the rocks, among which the golden manakin (*Pipra rupicola*), one of the most beautiful birds of the tropics, builds its nest. At the Raudalito of Carucari they entered some of the caverns formed by the piling up of granite blocks, and enjoyed the extraordinary spectacle of the river dashing in a sheet of foam over their heads. The boat was to coast the eastern bank of a narrow island, and take them in after a long circuit; but it did not make its appearance, and night approaching, together with a tremendous thunder-storm, M. Bonpland was desirous of swimming across, in order to seek assistance at Atures from Father Zea. Humboldt, and the other person

Passage of
the great
falls.

Rapids of
Atures.

CHAP.

Crocodiles.

who was with them, dissuaded him with difficulty from so hazardous an enterprise ; and shortly after two large crocodiles made their appearance, attracted by the plaintive cries of the monkeys. At length the Indians arrived with the vessel, and the navigation was continued during part of the night. At Carichana the missionary received them with kindness. Here the travellers remained some days to recruit their exhausted strength, and M. Bonpland had the satisfaction of dissecting a manatee.

Mission of Uruana.

From Carichana they went in two days to the mission of Uruana, the situation of which is extremely picturesque, the village being placed at the foot of a lofty granitic mountain, the columnar rocks appearing at intervals above the trees. Here the river is more than 5530 yards broad, and runs in a straight line directly east. The hamlet is inhabited by the Otomacs, one of the rudest of the American tribes. These Indians swallow quantities of earth for the purpose of allaying hunger. When the waters are low they live on fish and turtles : but when the rivers swell, and it becomes difficult to procure that food, they eat daily a large portion of clay. The travellers found in their huts heaps of it in the form of balls, piled up in pyramids three or four feet high. This substance is fine and unctuous, of a yellowish-gray colour, containing silica and alumina, with three or four per cent. of lime. Being a restless and turbulent people, with unbridled passions and excessively given to intoxication, the little village of Uruana is more difficult to govern than any of the other missions. By inhaling at the nose the powder obtained from the pods of the *Acacia niopo* they throw themselves into a state of intoxication bordering on madness, that lasts several days, during which dreadful murders are committed. The most vindictive cover the nail of the thumb with the curare poison, the slightest scratch being thus sufficient to produce death. When this crime is perpetrated at night they throw the body into the river. "Every time," said the monk, "that I see the women

Edible clay.

fetch water from a part of the shore to which they do not usually go for it, I suspect that a murder has been committed in my mission."

CHAP. XIX.

On the 7th June the travellers took leave of Father Ramon Bueno, whom Humboldt eulogizes as the only one of ten missionaries of Guiana whom they had seen who appeared to be attentive to any thing that regarded the natives. The night was passed at the island of Cucurupara, to the east of which is the mouth of the Cano de la Tortuga. On its southern bank is the almost deserted station of San Miguel de la Tortuga; in the neighbourhood of which, according to the Indians, are otters with a very fine fur, and lizards with two feet.

Father
Ramon
Bueno.

From the island of Cucurupara to Angostura, the capital of Guiana, a distance of little less than 328 miles, the travellers were only nine days on the water. On the 8th June they landed at a farm opposite the mouth of the Apure, where Humboldt obtained some good observations of latitude and longitude; and on the 9th met a great number of boats laden with goods, on their way to that river. Here Don Nicolas Soto, who had accompanied them on their voyage to the Rio Negro, took leave and returned to his family. As they advanced, the population became more considerable, consisting almost exclusively of whites, negroes, and mulattoes. On the 11th they passed the mouth of the Rio Caura, near which is a small lake formed in 1790 by the sinking of the ground in consequence of an earthquake. The Boca del Infierno and the Raudal de Camiseta, a series of whirlpools and rapids caused by a chain of small rocks, were the only remarkable features that occurred until they reached Angostura.

Rate of
ourney.Increasing
population.

On arriving at the capital, they hastened to present themselves to Don Felipe de Ynciarte, the governor of Guiana, who received them in the most obliging manner. A painful circumstance forced them to remain a whole month in this place. They were both, a few days after their arrival, attacked by a disorder, which in M. Bon-

Arrival at
Angostura.

CHAP. XIX

Attack of
fever.

pland assumed the character of a typhoid fever. A mulatto servant, who had attended them from Cumana, was similarly affected. His death was announced on the ninth day; but he had only fallen into a state of insensibility which lasted several hours, and was followed by a salutary crisis. Humboldt escaped with a very violent attack, during which he was made to take a mixture of honey and the extract of *Cortex angosturæ*. He recovered on the following day. His fellow-traveller remained in a very alarming state for several weeks, but retained sufficient strength of mind to prescribe for himself. His fever was incessant, and complicated with dysentery; but, in his case too, the issue was favourable. At this period no epidemic prevailed in the town, and the air was salubrious; so that the germ of the disease had probably been caught in the damp forests of the Upper Orinoco.

Angostura.

Angostura, so named from its being placed on a narrow part of the river, stands at the foot of a hill of hornblende-slate, destitute of vegetation. The streets are regular, and generally parallel to the course of the stream. The houses are high, agreeable, and built of stone; although the town is not exempt from earthquakes. At the period of this visit the population was only 6600. There is little variety in the surrounding scenery; but the view of the river is singularly majestic. When the waters are high they inundate the quays, and it sometimes happens that even in the streets imprudent persons fall a prey to the crocodiles, which are very numerous.

Crocodiles.

Humboldt relates that, at the time of his stay at Angostura, an Indian from the island of Margarita having gone to anchor his canoe in a cove where there were not three feet of water, a very fierce crocodile that frequented the spot seized him by the leg and carried him off. With astonishing courage he searched for a knife in his pocket, but not finding it, thrust his fingers into the animal's eyes. The monster, however, did not

let go his hold, but plunged to the bottom of the river, and after drowning his victim, came to the surface and dragged the body to an island. CHAP. XIX.

The number of individuals who perish annually in this manner is very great, especially in villages where the neighbouring grounds are inundated. The same crocodiles remain long in the same places, and become more daring from year to year, especially, as the Indians assert, if they have once tasted human flesh. They are not easily killed, as their skin is impenetrable,—the throat and the space beneath the shoulder being the only parts where a ball or spear can enter. The natives catch them with large iron hooks baited with meat, and attached to a chain fastened to a tree. After the animal has struggled for a considerable time, they attack it with lances.

Affecting examples are related of the intrepidity of African slaves in attempting to rescue their masters from the jaws of these voracious reptiles. Not many years ago, in the Llanos of Calabozo, a negro, attracted by the cries of his owner, armed himself with a long knife, and plunging into the river, forced the animal, by scooping out its eyes, to leave its prey and take to flight. The natives being daily exposed to similar dangers think little of them. They observe the manners of the crocodile as the torero studies those of the bull; and quietly calculate the motions of the enemy, its means of attack, and the degree of its audacity.

The general nature of the vast regions bordering on the Orinoco may be sufficiently learned from the above condensed narrative; and we think it unnecessary to follow our learned author through his description of that portion of the river which extends from Angostura to its mouths, especially as it is not founded on personal observation. Summary.

CHAPTER XX.

Journey across the Llanos to New Barcelona.

Departure from Angostura—Village of Cari—Natives—New Barcelona—Hot Springs—Crocodiles—Passage to Cumana.

CHAP. XX.
Departure
from Angos-
tura.

It was night when our travellers for the last time crossed the bed of the Orinoco. They intended to rest near the little fort of San Rafael, and in the morning begin their journey over the Llanos of Venezuela, with the view of proceeding to Cumana or New Barcelona, whence they might sail to the island of Cuba and thence again to Mexico. There they purposed to remain a year, and to take a passage in the galleon from Acapulco to Manilla.

Objects
collected.

The botanical and geological collections which they had brought from Esmeralda and the Rio Negro had greatly increased their baggage ; and, as it would have been hazardous to lose sight of such stores, they journeyed but slowly over the deserts, which they crossed in thirteen days. This eastern part of the Llanos, between Angostura and Barcelona, is similar to that already described on the passage from the valley of Aragua to San Fernando de Apure ; but the breeze is felt with greater force, although at this period it had ceased. They spent the first night at the house of a Frenchman, a native of Lyons, who received them with the kindest hospitality. He was employed in joining wood by means of a kind of glue called guayca, which resembles the best made from animal substances, and is

found between the bark and alburnum of the *Combretum guayca*, a kind of creeping plant. CHAP. XX.

On the third day they arrived at the missions of Cari. Missions of
Cari. Some showers had recently revived the vegetation. A thick turf was formed of small grasses and herbaceous sensitive plants, while a few fan-palms, rhopalas, and malpighias, rose at great distances from each other. The humid spots were distinguishable by groups of mauritias, which were loaded with enormous clusters of red fruit. The plain undulated from the effect of mirage, the heat was excessive, and the travellers found temporary relief under the shade of the trees, which had, however, attracted numerous birds and insects.

On the 13th July they arrived at the village of Cari, Village of
Cari. where, as usual, they lodged with the clergyman, who could scarcely comprehend how natives of the north of Europe should have arrived at his dwelling from the frontiers of Brazil. They found more than 500 Caribs in the hamlet, and saw many more at the surrounding missions. They were of large stature, from five feet ten inches to six feet two. The men had the lower part of the body wrapped in a piece of dark-blue cloth, while the women had merely a narrow band. Caribs. This race differs from the other Indians, not only in being taller, but also in the greater regularity of their features, in having the nose less flattened, and the cheekbones less prominent. The hair of the head is partially shaven, only a circular tuft being left on the top,—a custom that might be supposed to have been borrowed from the monks, but which is equally prevalent among those who have preserved their independence. Both males and females are careful to ornament their persons with paint. The Caribs, once so powerful, now inhabit but a small part of the country which they occupied at the time when America was discovered. They have been exterminated in the West India Islands and the coasts of Darien, but in the provinces of New Barcelona and Spanish Guiana have formed populous villages, under the government of the missions. Humboldt estimates the number inhabiting

CHAP. XX.

Number of
Caribs.

the Llanos of Piritoo and the banks of the Caroni and Cuyuni at more than 35,000, and the total amount of the pure race at 40,000.

The missionary led the travellers into several huts, where they found the greatest order and cleanliness, but were shocked by the torments that the women inflicted on their infants, for the purpose of raising the flesh in alternate bands from the ankle to the top of the thigh, —a practice which the monks had in vain attempted to abolish. This effect was produced by narrow ligatures, which seemed to obstruct the circulation of the blood, although it did not weaken the action of the muscles. The forehead, however, was not flattened, but left in its natural form.

Indian
prejudices.

On leaving the mission the philosophers had some difficulty in settling with their Indian muleteers, who had discovered among the baggage the skeletons brought from the cavern of Atarupe, and were persuaded that the animals which carried such a load would perish on the journey. The Rio Cari was crossed in a boat, and the Rio de Agua Clara by fording. The same objects every where recurred; huts constructed of reeds and roofed with skins; mounted men guarding the herds; cattle, horses, and mules, running half wild. No sheep or goats were seen, these animals being unable to escape from the jaguars.

Fruit-trees.

On the 15th they arrived at the Villa del Pao, where they found some fruit-trees as well as cocoa-palms, which properly belong to the coast. As they advanced the sky became clearer, the soil more dusty, and the atmosphere more fiery. The intense heat, however, was not entirely owing to the temperature of the air, but arose partly from the fine sand mingled with it. On the night of the 16th they rested at the Indian village of Santa Cruz de Cachipo. The warmth had increased so much that they would have preferred travelling by night; but the country was infested by robbers, who murdered the whites that fell into their hands. These were malefactors who had escaped from the prisons on

the coast and from the missions, and lived in the Llanos in a manner similar to that of the Bedouin Arabs. Those vast plains, Humboldt thinks, can hardly ever be subjected to cultivation ; although he is persuaded that in the lapse of ages, if placed under a government favourable to industry, they will lose much of the wild aspect which they have hitherto retained.

CHAP. XX.

Native
robbers.

After travelling three days they began to perceive the chain of the mountains of Cumana, which separates the Llanos from the coast of the Caribbean Sea. It appeared at first like a fog-bank, which by degrees condensed, assumed a bluish tint, and became bounded by sinuous outlines. Although the Llanos of Venezuela are bordered on the south by granitic mountains exhibiting in their broken summits traces of violent convulsions, no blocks were found scattered upon them. The same remark is to be made in regard to the other great plains of South America. These circumstances, as Humboldt remarks, seem to prove that the granitic masses scattered over the sandy plains of the Baltic are a local phenomenon, and must have originated in some great convulsion which took place in the northern regions of Europe.

Mountains
Cumana.

On the 23d July they arrived at the town of New Barcelona, less fatigued by the heat to which they had been so long accustomed, than harassed by the sand-wind, that causes painful chaps in the skin. They were kindly received by a wealthy merchant of French extraction, Don Pedro Lavie. This town was founded in 1637, and in 1800 contained more than 16,000 inhabitants. The climate is not so hot as that of Cumana, but very damp, and in the rainy season rather unhealthy. M. Bonpland had by this time regained his strength and activity, but his companion suffered more at Barcelona than he had done at Angostura. One of those extraordinary tropical rains, during which drops of enormous size fall at sunset, had produced uneasy sensations that seemed to threaten an attack of typhus,—a disease then prevalent on the coast. They remained nearly a month

New Barce-
lona.

CHAP. XX.

at Barcelona, where they found their friend Juan Gonzales, who, having resolved to go to Europe, meant to accompany them as far as Cuba.

Mountain chain.

At the distance of seven miles to the south-east of New Barcelona rises a chain of lofty mountains connected with the Cerro del Bergantin, which is seen from Cumana. When Humboldt's health was sufficiently restored, the travellers made an excursion in that direction, for the purpose of examining the hot springs in the neighbourhood. These are impregnated with sulphuretted hydrogen, and issue from a quartzose sandstone, lying on a compact limestone resembling that of Jura. The temperature of the water was 109·8°. Their host had lent them his finest saddle-horses, warning them at the same time not to ford the little river of Narigual, which is infested with crocodiles. They passed over by a kind of bridge formed of the trunks of trees, and made their animals swim, holding them by the bridles. Humboldt's suddenly disappeared, and the guides conjectured that it had been seized by the caymans.

Rio Neveri.

The crocodiles of the Rio Neveri are numerous, but less ferocious than those of the Orinoco. The people of New Barcelona convey wood to market, by floating the logs on the river, while the proprietors swim here and there to set them loose when they are stopped by the banks. This could not be done in most of the South American rivers infested by those animals. There is no Indian suburb as at Cumana, and the few natives seen in the town are from the neighbouring missions, or inhabitants of huts scattered in the plain. They are of a mixed race, indolent, and addicted to drinking.

Detention of packet-boats.

The packet-boats from Corunna to Havannah and Mexico had been due three months, so that they were supposed to have been taken by the English cruisers; when our travellers, anxious to reach Cumana, in order to avail themselves of the first opportunity for Vera Cruz, hired an open vessel. It was laden with cacao, and carried on a contraband trade with the island of

Trinidad ; for which reason the proprietor thought he had nothing to fear from the British ; but they had scarcely reached the narrow channel between the continent and the islands of Boracha and the Chimanas, when they met an armed boat which, hailing them at a great distance, fired some musket-shot at them. It belonged to a privateer of Halifax, and the travellers were forthwith carried on board ; but while Humboldt was negotiating in the cabin, a noise was heard upon deck, and something was whispered to the master, who instantly left him in consternation. An English sloop of war, the Hawk, had come up, and made signals to the latter to bring to ; which he not having promptly obeyed, a gun was fired, and a midshipman sent to demand the reason. Humboldt accompanied this officer to the sloop, where Captain Garnier received him with the greatest kindness. Next day they continued their voyage, and at nine in the morning reached the Gulf of Cariaco. The castle of San Antonio, the forest of cactuses, the scattered huts of the Guayqueras, and all the features of a landscape well known to them, rose upon the view ; and on their landing at Cumana they were greeted by their numerous friends, who were overjoyed to find untrue a report of their death on the Orinoco, which had been current for several months. The port was every day more strictly blockaded, and the vain expectation of Spanish packets detained them two months and a half longer ; during which time they occupied themselves in completing their investigation of the plants of the country ; in examining the geology of the eastern part of the peninsula of Araya ; and in making astronomical observations, together with experiments on refraction, evaporation, and atmospheric electricity. They also sent off some of their more valuable collections to France.

Having been informed that the Indians brought to the town considerable quantities of native alum found in the mountains, they made an excursion for the purpose of ascertaining its position. Disembarking near

CHAP. XX.

Capture by a privateer.

Recapture and deliverance.

Landing at Cumana.

Native alum.

CHAP. XX. Cape Caney they inspected the old salt-pit, now converted into a lake by an irruption of the sea; the ruins of the castle of Araya; and the limestone-mountain of Barigon, which contained fossil-shells in perfect preservation. When they visited that peninsula the preceding year, there was a dreadful scarcity of water. But during their absence on the Orinoco it had rained abundantly on various parts along the coast; and the remembrance of these showers occupied the imagination of the natives as a fall of meteoric stones would engage that of the naturalists of Europe.

Search for
the alum
works.

Their Indian guide was ignorant of the situation of the alum, and they wandered for eight or nine hours among the rocks, which consisted of mica-slate passing into clay-slate, traversed by veins of quartz, and containing small beds of graphite. At length, descending toward the northern coast of the peninsula, they found the substance for which they were searching, in a ravine of very difficult access. Here the mica-slate suddenly changed into carburetted and shining clay-slate, and the springs were impregnated with yellow oxide of iron. The sides of the neighbouring cliffs were covered with capillary crystals of sulphate of alumina, and real beds, two inches thick, of native alum, extended in the clay-slate as far as the eye could reach. The formation appeared to be primitive, as it contained cyanite, rutile, and garnets.

Departure
from
Cumana.

Returning to Cumana, they made preparations for their departure, and availing themselves of an American vessel, laden at New Barcelona for Cuba, they set out on the 16th November, and crossed for the third time the Gulf of Cariaco. The night was cool and delicious, and it was not without emotion that they saw for the last time the disk of the moon illuminating the summits of the cocoa-trees along the banks of the Manzanares. The breeze was strong, and in less than six hours they anchored near the Morro of New Barcelona.

The continental part of the New World is divided between three nations of European origin, of which one,

the most powerful, is of Germanic race, and the two others belong to Latin Europe. The latter are more numerous than the former; the inhabitants of Spanish and Portuguese America constituting a population double that of the regions possessed by the English. The French, Dutch, and Danish possessions of the New Continent are of small extent, and the Russian colonies are as yet of little importance. The free Africans of Hayti are the only other people possessed of territory excepting the native Indians. The British and Portuguese colonists have peopled only the coasts opposite to Europe; but the Spaniards have passed over the Andes, and made settlements in the most western provinces, where alone they discovered traces of ancient civilisation. In the eastern districts, the inhabitants who fell into the hands of the two former nations were wandering tribes or hunters, while in the remoter parts the Spaniards found agricultural states and flourishing empires; and these circumstances have greatly influenced the present condition of these countries. Among other instances may be mentioned the almost total exclusion of African slaves from the latter colonies, and the comfortable condition of the natives of American race, who live by agriculture, and are governed by European laws.

But with respect to the political constitution and relations of the provinces visited by the travellers, it is not expedient here to enter into the details which they have given, more especially as those colonies have lately undergone revolutions that have converted them into independent states, the history of which would afford materials for many volumes. The very interesting sketch of the physical constitution of South America presented by Humboldt must also be passed over, because in the condensed form to which it would necessarily be reduced, it could not afford an adequate idea of the subject. We must therefore, with our travellers, take leave of Terra Firma, and accompany them on their passage to Havannah.

CHAP. XX.

European
races.

Haytians.

Political
changes.

CHAPTER XXI.

Passage to Havannah, and Residence in Cuba.

Passage from New Barcelona to Havannah—Description of the latter—Extent of Cuba—Geological Constitution—Vegetation—Climate—Population—Agriculture—Exports—Preparations for joining Captain Baudin's Expedition—Journey to Batabano, and Voyage to Trinidad de Cuba.

CHAP. XXI.

Departure
from New
Barcelona.

Marine
phenomenon.

HUMBOLDT and his companion sailed from the Road of New Barcelona on the 24th November at nine in the evening, and next day at noon reached the island of Tortuga, remarkable for its lowness and want of vegetation. On the 26th there was a dead calm, and about nine in the morning a fine halo formed round the sun, while the temperature of the air fell three degrees. The circle of this meteor, which was one degree in breadth, displayed the most beautiful colours of the rainbow, while its interior and the whole vault of the sky was azure without the least haze. The sea was covered with a bluish scum, which under the microscope appeared to be formed of filaments, that seemed to be fragments of fuci. On the 27th they passed near the island of Orchila, composed of gneiss and covered with plants, and toward sunset discovered the summits of the Roca de Afuera, over which the clouds were accumulated. Indications of stormy weather increased, the waves rose, and waterspouts threatened. On the night of the 2d December a curious optical phenomenon presented itself. The full moon was very high. On its side,

forty-five minutes before its passage over the meridian, a great arc suddenly appeared, having the prismatic colours, but of a gloomy aspect. It seemed higher than the moon, had a breadth of nearly two degrees, and remained stationary for several minutes; after which it gradually descended, and sank below the horizon. The sailors were filled with astonishment at this moving arch, which they supposed to announce wind. Next night M. Bonpland and several passengers saw, at the distance of a quarter of a mile, a small flame, which ran on the surface of the sea towards the south-west, and illuminated the atmosphere. On the 4th and 6th they encountered rough weather, with heavy rain accompanied by thunder, and were in considerable danger on the bank of Vibora. At length, on the 19th, they anchored in the port of Havannah, after a boisterous passage of twenty-five days.

CHAP. XXI.
Optical phenomenon.

Cuba is the largest of the West India Islands, and on account of its great fertility, its naval establishments, the nature of its population,—of which three-fifths are composed of free men,—and its geographical position, is of great political importance. Of all the Spanish colonies it is that which has most prospered; insomuch, that not only has its revenue sufficed for its own wants, but during the struggle between the mother-country and her continental provinces, it furnished considerable sums to the former.

The appearance which Havannah presents at the entrance of the port is exceedingly beautiful and picturesque. The opening is only about 426 yards wide, defended by fortifications; after which a basin, upwards of two miles in its greatest diameter, and communicating with three creeks, expands to the view. The city is built on a promontory, bounded on the north by the fort of La Punta, and on the south by the arsenals. On the western side it is protected by two castles, placed at the distance of 1407 and 2643 yards from the walls, the intermediate space being occupied by the suburbs. The public edifices are less remarkable for their beauty than

CHAP. XXI.

for the solidity of their construction, and the streets are in general narrow and unpaved, in consequence of which they are extremely dirty and disagreeable. But there are two fine public walks to which the inhabitants resort.

Population. Although the town of Havannah, properly so called, is only 1918 yards long and 1066 broad, it contained in 1927 a population of 39,980 within the walls, and 54,043 in the suburbs. These were divided as follow :—

Whites,.....	46,621	
Free Pardos or Mulattoes,.....	8,215	} ...23,562
Free Blacks.....	15,347	
Pardos or Mulatto Slaves,.....	1,010	} ...23,840
Black Slaves,.....	22,830	
		94,023

Hospitals There are two hospitals in the town, the number of sick admitted into which is considerable. Owing to the heat of the climate, the filth of the town, and the influence of the shore, there is usually a great accumulation of disease, and the yellow fever or black vomiting is prevalent. The markets are well supplied.

Palma real. A peculiar character is given to the landscape in the vicinity of Havannah by the palma real (*Oreodoxa regia*), the trunk of which, enlarged a little towards the middle, attains a height varying from 60 to 85 feet, and is crowned by pinnated leaves rising perpendicularly, and curved at the point. Numerous country-houses of light and elegant construction surround the bay, to which the proprietors retreat when the yellow fever rages in the town.

Extent of Cuba. The island of Cuba is nearly as large as Portugal ; its greatest length being 784 miles, and its mean breadth $51\frac{3}{4}$ miles. More than four-fifths of its extent is composed of low lands ; but it is traversed in various directions by ranges of mountains, the highest of which are said to attain an altitude of 7674 feet. The western part consists of granite, gneiss, and primitive slates ; which, as well as the central district, contains two formations of compact limestone, one of argillaceous

sandstone, and another of gypsum. The first of these presents large caves near Matanzas and Jaruco, and is filled with numerous species of fossils. The secondary formations to the east of the Havannah are pierced by syenitic and euphotide rocks, accompanied with serpentine. No volcanic eruptions, properly so called, have hitherto been discovered.

CHAP. XXI.

Caves.

Owing to the cavernous structure of the limestone deposits, the great inclination of their strata, the small breadth of the island, and the frequency and nakedness of the plains, there are very few rivers of any magnitude, and a large portion of the territory is subject to severe droughts. Yet the undulating surface of the country, the continually renewed verdure, and the distribution of vegetable forms, give rise to the most varied and beautiful landscapes. The hills and savannahs are decorated by palms of several species, trees of other families, and shrubs constantly covered with flowers. Wild orange-trees ten or fifteen feet in height, and bearing a small fruit, are common, and probably existed before the introduction of the cultivated variety by Europeans. A species of pine (*Pinus occidentalis*) occurs here and in San Domingo, but has not been seen in any of the other West India Islands.

Limestone.

The climate of Havannah, although tropical, is marked by an unequal distribution of heat at different periods of the year, indicating a transition to the climates of the temperate zone. The mean temperature is 78·3°, but in the interior only 73·4°. The hottest months, July and August, do not give a greater average than 83·8°, and the coldest, December and January, present the mean of 69·8°. In summer the thermometer does not rise above 82° or 86°, and its depression in winter so low as 50° or 53·5° is rare. When the north wind blows several weeks, ice is sometimes formed at night at a little distance from the coast, at an inconsiderable elevation above the sea. Yet the great lowerings of temperature which occasionally take place are of so short duration, that the palm-trees, bananas, or the sugar-cane, do not suffer

Climate.

258 POPULATION AND AGRICULTURE OF CUBA.

CHAP. XXI from them. Snow never falls, and hail so rarely that it is only observed during thunder-storms, and with blasts from the S.S.W. once in fifteen or twenty years. The changes however are very rapid, and the inhabitants complain of cold when the thermometer falls quickly to 70°. Hurricanes are of much less frequent occurrence in Cuba than in the other West India Islands.

Meteorology.

Population. According to the census of 1827 the population of the whole island amounted to 704,487, or, adding the military and seamen (26,075), to 730,562. Of these 311,051 were whites, 106,494 free coloured men, and 286,942 slaves. The original inhabitants have entirely disappeared, as in all the other West India Islands. Intellectual cultivation is almost entirely restricted to the whites; and although in Havannah the first society is not perceptibly inferior to that of the richest commercial cities in Europe, a rudeness of manners prevails in the small towns and plantations.

Grasses. The common cereal grasses are cultivated in Cuba, together with the tropical productions peculiar to these countries; but the principal exports consist of tobacco, coffee, sugar, and wax. The sugar-cane is planted in the rainy season, from July to October, and cut from February to May. The rapid diminution of wood in the island has caused the want of fuel to be felt in the manufacture of sugar, and Humboldt, during his stay, attempted several new constructions, with the view of diminishing the expenditure of it.*

Tobacco. The tobacco of Cuba is celebrated in every part of Europe. The districts which produce the most aromatic kind are situated to the west of the Havannah, in the Vuelta de Abajo; but that grown to the east of the

* By the Custom-house returns, 156,158,924 lbs. of sugar were exported from Cuba in 1827; and if the quantity smuggled be estimated at one-fourth more, the total amount would be nearly 200,000,000 lbs. In the same year the exportation of coffee amounted to upwards of 50,000,000 lbs., but it has since fallen off considerably.—See *Macculloch's Dict. of Commerce*, art. Havannah.

capital on the banks of the Mayari, in the province of Santiago, at Himias, and in other places, is also of excellent quality. In 1827 the produce was about 113,212 cwts., of which 17,888 were exported. The value of this commodity shipped in 1828 was £145,045, and in 1829, £195,588. Cotton and indigo, although cultivated, are not to any extent made articles of commerce.

Towards the end of February the travellers, having finished the observations which they had proposed to make, were on the point of sailing to Vera Cruz ; but intelligence, communicated by means of the public papers, respecting Captain Baudin's expedition, led them to relinquish the project of crossing Mexico in order to proceed to the Philippine Islands. It had been announced that two French vessels, the *Geographe* and the *Naturaliste*, had sailed for Cape Horn, and that they were to go along the coast of Chili and Peru, and from thence to New Holland. Humboldt had promised to join them wherever he could reach the ships, and M. Bonpland resolved to divide their plants into three portions, one of which was sent to Germany by way of England, another to France by Cadiz, and the third left in Cuba. Their friend Fray Juan Gonzales, an estimable young man, who had followed them to the Havannah, on his way to Spain, carried part of their collections with him, including the insects found on the Orinoco and Rio Negro ; but the vessel in which he embarked foundered in a storm on the coast of Africa. General Don Gonzalo O'Farrill being then in Prussia as minister of the Spanish court, Humboldt was enabled, through the agency of Don Ygnacio, the general's brother, to procure a supply of money ; and having made all the necessary preparations for the new enterprise, freighted a Catalonian sloop for Porto Bello, or Carthagena, according as the weather should permit.

On the 6th March the travellers, finding that the vessel was ready to receive them, set out for Batabano, where they arrived on the 8th. This is a poor village

CHAP. XXI
ExportProposed
departure.Captain
Baudin's
expedition.Pecuniary
supplies.

CHAP. XXI. surrounded by marshes, covered with rushes and plants of the Iris family, among which appear here and there a few stunted palms. The marshes are infested by two species of crocodile, one of which has an elongated snout, and is very ferocious. The back is dark-green, the belly white, and the flanks are covered with yellow spots.

Batabano.

Departure. On the 9th of March our travellers again set sail in a small sloop, and proceeded through the gulf of Batabano, which is bounded by a low and swampy coast. Humboldt employed himself in examining the influence which the bottom of the sea produces on the temperature of its surface, and in determining the position of some remarkable islands. The water of the gulf was so shallow, that the sloop often struck; but the ground being soft and the weather calm, no damage was sustained. At sunset they anchored near the pass of Don

**Pass of Don
Cristoval.**

Cristoval, which was entirely deserted, although in the time of Columbus it was possessed by fishermen. The inhabitants of Cuba then employed a singular method for procuring turtles; they fastened a long cord to the tail of a species of *echineis* or sticking-fish, which has a flat disk with a sucking apparatus on its head. By means of this it stuck to the turtle, and was pulled ashore carrying the latter with it. The same artifice is resorted to by the natives of certain parts of the African coast.

**Archipelago
of the Jar-
dines.**

They were three days on their passage through the Archipelago of the Jardines and Jardinillos, small islands and shoals partly covered with vegetation; remaining at anchor during the night, and in the day visiting those which were of most easy access. The rocks were found to be fragmentary, consisting of pieces of coral, cemented by carbonate of lime, and interspersed with quartz sand. On the Cayo Bonito, where they first landed, they observed a layer of sand and broken shells five or six inches thick, covering a formation of madrepore. It was shaded by a forest of rhizophoræ, intermixed with euphorbiæ, grasses, and other plants,

together with the magnificent *Tournefortia gnaphaloides*, with silvery leaves and odoriferous flowers. The sailors had been searching for langoustes; but not finding any, avenged themselves on the young pelicans perched on the trees. The old birds hovered around, uttering hoarse and plaintive cries, and the young defended themselves with vigour, although in vain; for the sailors, armed with sticks and cutlasses, made cruel havoc among them. "On our arrival," says Humboldt, "a profound calm prevailed on this little spot of earth; but now every thing seemed to say,—Man has passed here."

On the morning of the 11th they visited the Cayo Flamenco, the centre of which is depressed, and only 15 inches above the surface of the sea. The water was brackish, while in other cayos it is quite fresh,—a circumstance difficult to be accounted for in small islands scarcely elevated above the ocean, unless the springs be supposed to come from the neighbouring coast by means of hydrostatic pressure. Humboldt was informed by Don Francisco le Maur, that in the bay of Xagua, to the east of the Jardinillos, fresh water gushes up in several places from the bottom with such force as to prove dangerous for small canoes. Vessels sometimes take in supplies from them; and the lamantins, or fresh-water cetacea, abound in the neighbourhood.

To the east of Cape Flamenco they passed close to the Piedras de Diego Perez, and in the evening landed at Cayo de Piedras, two rocks forming the eastern extremity of the Jardinillos, on which many vessels are lost. They are nearly destitute of shrubs, the shipwrecked crews having cut them down to make signals. Next day, turning round the passage between the northern cape of the cayo and the island of Cuba, they entered a sea free from breakers, and of a dark-blue colour; the increase of temperature in which indicated a great augmentation of depth. The thermometer was at 79·2°; whereas in the shoal-water of the Jardinillos it had been seen as low as 72·7°, the air being from 77° to

CHAP. XXII. 80° 6' during the day. Passing in succession the marshy coast of Camareos, the entrance of the Bahía de Xagua, and the mouth of the Río San Juan, along a naked and desert coast, they entered on the 14th the Río Guaurabo to land their pilot. Disembarking in the evening, they made preparations for observing the passage of certain stars over the meridian, but were interrupted by some merchants that had dined on board a foreign ship newly arrived, and who invited the strangers to accompany them to the town; which they did, mounted two and two on the same horse. The road to Trinidad is nearly five miles in length, over a level plain covered with a beautiful vegetation, to which the Miraguama palm, a species of corypha, gave a peculiar character. The houses are situated on a steep declivity, about 746 feet above the level of the sea, and command a magnificent view of the ocean, the two ports, a forest of palms, and the mountains of San Juan. The travellers were received with the kindest hospitality by the administrator of the Real Hacienda, M. Munoz. The Teniente Gobernador, who was nephew to the celebrated astronomer Don Antonio Ulloa, gave them a grand entertainment, at which they met with some French emigrants of San Domingo. The evening was passed very agreeably in the house of one of the richest inhabitants, Don Antonio Padron, where they found assembled all the select company of the place. Their departure was very unlike their entrance; for the municipality caused them to be conducted to the mouth of the Río Guaurabo in a splendid carriage, and an ecclesiastic dressed in velvet celebrated in a sonnet their voyage up the Orinoco.

Reception by M. Munoz.

Population of Trinidad.

The population of Trinidad, with the surrounding farms, was stated to be 19,000. It has two ports at the distance of about four miles, Puerto Casilda and Puerto Guaurabo. On their return to the latter of these the travellers were much struck by the prodigious number of phosphorescent insects which illuminated the grass and foliage. These insects (*Elater noctilucus*) are occasionally used for a lamp, being placed in a calabash

perforated with holes ; and a young woman at Trinidad CHAP. XXI.
informed them that, during a long passage from the mainland, she always had recourse to this light when she gave her child the breast at night, the captain not allowing any other on board for fear of pirates.

CHAPTER XXII.

Voyage from Cuba to Carthagena.

Passage from Trinidad of Cuba to Carthagena—Description of the latter—Village of Turbaco—Air-volcanoes—Preparations for ascending the Rio Magdalena.

CHAP. XXII. LEAVING the island of Cuba the travellers proceeded in a S.S.E. direction, and on the morning of the 17th approached the group of the Little Caymans, in the neighbourhood of which they saw numerous turtles of extraordinary size, accompanied by multitudes of sharks. Passing a second time over the great bank of Vibora, they remarked that the colour of the troubled waters upon it was of a dirty gray, and made observations on the changes of temperature at the surface, produced by the varying depth of the sea. On quitting this shoal they sailed between the Baxo Nueva and the lighthouse of Camboy. The weather was remarkably fine, and the surface of the bay was of an indigo-blue or violet tint, on account of the medusæ which covered it. Haloes of small dimensions appeared round the moon. The disappearance of one of them was followed by the formation of a great black cloud, which emitted some drops of rain; but the sky soon resumed its serenity, and a long series of falling-stars and fire-balls were seen moving in a direction contrary to the wind in the lower regions of the atmosphere, which blew from the north. During the whole of the 23d March not a single cloud was seen in the firmament, although the air and the horizon were

Departure
from Trin-
idad.

Lunar
haloes

tinged with a fine red colour ; but towards evening CHAP. XXII. large bluish clouds formed, and when they disappeared, Atmospheric converging bands of fleecy vapours were seen at an change. immense height. On the 24th they entered the kind of gulf bounded by the shores of Santa Martha and Costa Rica, which is frequently agitated by heavy gales. As they advanced toward the coast of Darien, the north-east wind increased to a violent degree, and the waves became very rough at night. At sunrise they perceived part of the archipelago of St Bernard, and passing the southern extremity of the Placa de San Bernardo, saw in the distance the mountains of Tigua. The stormy weather and contrary winds induced the master of the vessel to seek shelter in the Rio Sinu, after a passage of sixteen days.

Landing again on the continent of South America, Village of Zapota. they betook themselves to the village of Zapote, where they found a great number of sailors, all men of colour, who had descended the Rio Sinu in their barks, carrying maize, bananas, poultry, and other articles, to the port of Carthagena. The boats are flat-bottomed, and the wind having blown violently on the coast for ten days, they were unable to proceed on their voyage. These people fatigued the travellers with idle questions about their books and instruments, and tried to frighten them with stories of boas, vipers, and jaguars. Leaving Forest-trees. the shores, which are covered with *Rhizophora*, they entered a forest remarkable for the great variety of palm-trees which it presented. One of them, the *Eleis melanococca*, is only six feet four inches high, but its spathe contain more than 200,000 flowers, a single specimen furnishing 600,000 at the same time. The kernels of the fruit are peeled in water, and the layer of oil that rises from them, after being purified by boiling, yields the manteca de corozo, which is used for lighting churches and houses.

After an hour's walk they found several inhabitants Palm-wine. collecting palm-wine. The tree which affords this liquid is the *Palma dulce* or *Cocos butyracea*. The

CHAP. XXXII

Mode of
obtaining it.

Degrees of
strength.

Rio Sinu.

Rough sea.

trunk, which diminishes but little towards the summit, is first cut down, when an excavation eighteen inches long, eight broad, and six in depth, is made below the place at which the leaves and spathæ come off. After three days the cavity is found filled with a yellowish-white juice, having a sweet and vinous flavour, which continues to flow eighteen or twenty days. The last that comes is less sweet, but having a greater quantity of alcohol, it is more highly esteemed. On their way back to the shore they met with Zamboes, carrying on their shoulders cylinders of palmetto three feet in length, of which an excellent food is prepared. Night surprised them; and, having broken an oar in returning on board, they found some difficulty in reaching the vessel.

The Rio Sinu is of the highest importance for provisioning Carthagena. The gold-washings, which were formerly of great value, especially between its source and the village of San Geronimo, have almost entirely ceased, although the province of Antioquia still furnishes, in its auriferous veins, a vast field for mining speculations. It would, however, be of more importance to direct attention to the cultivation of colonial produce in these districts, especially that of cacao, which is of superior quality. The real febrifuge *Cinchona* also grows at the source of the Rio Sinu, as well as in the mountains of Abibé and Maria; and the proximity of the port of Carthagena would enhance its value in the trade with Europe.

On the 27th March the sloop weighed anchor at sunrise. The sea was less agitated, although the wind blew as before. To the north was seen a succession of small conical mountains, rising in the midst of savannahs, where the balsam of Tolu, formerly so celebrated as a medicament, is still gathered. On leaving the gulf of Morosquillo they found the waves swelling so high, that the captain was glad to seek for shelter, and lay to on the north of the village of Rincon; but discovering that they were upon a coral rock, they preferred the open water, and finally anchored near the isle of Arenas,

on the night of the 28th. Next day the gale blew with great violence ; but they again proceeded, hoping to be able to reach the Boca Chica. The sea was so rough as to break over the deck, and while they were running short tacks, a false manœuvre in setting the sails exposed them for some minutes to imminent danger. It was Palm Sunday ; and a Zambo, who had followed them to the Orinoco, and remained in their service until they returned to France, did not fail to remind them, that on the same day the preceding year they had undergone a similar danger near the mission of Uruana. After this they took refuge in a creek of the iale of Baru.

As there was to be an eclipse of the moon that night, and next day an occultation of α Virginis, Humboldt insisted that the captain should allow one of the sailors to accompany him by land to the Boca Chica, the distance being only six miles ; but the latter refused, on account of the savage state of the country, in which there was neither path nor habitation ; and an incident which occurred justified his prudence. The travellers were going ashore to gather plants by moonlight, when there issued from the thicket a young negro loaded with fetters and armed with a cutlass. He urged them to disembark on a beach covered with large *Rhizophoræ*, among which the sea did not break, and offered to conduct them to the interior of the island of Baru it they would give him some clothes ; but his cunning and savage air, his repeated inquiries as to their being Spaniards, and the unintelligible words addressed to his companions who were concealed among the trees, excited their suspicions, and induced them to return on board. These blacks were probably Maroon negroes, who had escaped from prison. The appearance of a naked man, wandering on an uninhabited shore, and unable to rid himself of the chains fastened round his neck and arm, left a painful impression on the travellers ; but the sailors felt so little sympathy with these miserable

CHAP. XXII.
Danger at
sea.

Lunar
eclipse.

Runaway
negro.

Painful
sight.

CHAP. XXII. creatures, that they wished to return and seize the fugitives, in order to sell them at Carthagena.

Punta Gigantea.

Next morning they doubled the Punta Gigantes, and made sail towards the Boca Chica, the entrance to the port of Carthagena, which is eight or ten miles farther up. On landing, Humboldt learned that the expedition appointed to make a survey of the coast, under the command of M. Fidalgo, had not yet put to sea, and this circumstance enabled him to ascertain the astronomical position of several places which it was of importance to determine.

Excursion at Carthagena.

During the six days of their stay at Carthagena, they made excursions in the neighbourhood, more especially in the direction of the Boca Grande, and the hill of Popa, which commands the town. The port or bay is nearly eleven miles long. The small island of Tierra Bomba, at its two extremities, which approach, the one to a neck of land from the continent, the other to a cape of the isle of Bani, forms the only entrances to the harbour.

Boca Grande.

One of these, named Boca Grande, has been artificially closed for the defence of the town, in consequence of an attack attended with partial success made by Admiral Vernon in 1741. The extent of the work was 2640 varas, or 2345 yards, and as the water was from 14 to 20 feet deep, a wall or dike of stone, from 16 to 21 feet high, was raised on piles. The other opening, the Boca Chica, is about 550 yards broad, but is daily becoming narrower, while the currents acting upon the Boca Grande have opened a breach in it, which they are continually extending.

Climate.

The insalubrity of Carthagena, which has been exaggerated, varies with the state of the great marshes that surround it. The Cienega de Tesca, which is upwards of eighteen miles in length, communicates with the ocean; and, when in dry years the salt water does not cover the whole plain, the exhalations that rise from it during the heat of the day become extremely pernicious. The hilly ground in the neighbourhood of

the town is of limestone, containing petrifications, and is covered by a gloomy vegetation of cactus, *Jatropha gossypifolia*, croton, and mimosa. While the travellers were searching for plants, their guides showed them a thick bush of *acacia cornigera*, which had acquired celebrity from the following occurrence: A woman, wearied of the well-founded jealousy of her husband, bound him at night with the assistance of her paramour, and threw him into it. The thorns of this species of acacia are exceedingly sharp, and of great length, and the shrub is infested by ants. The more the unfortunate man struggled, the more severely was he lacerated by the prickles, and when his cries at length attracted some persons who were passing, he was found covered with blood, and cruelly tormented by the ants.

At Carthagena the travellers met with several persons whose society was not less agreeable than instructive; and in the house of an officer of artillery, Don Domingo Esquiaqui, found a very curious collection of paintings, models of machinery, and minerals. They had also an opportunity of witnessing the pageant of the Pascua. Nothing, says Humboldt, could rival the oddness of the dresses of the principal personages in these processions. Beggars, carrying a crown of thorns on their heads, asked alms, with crucifixes in their hands, and habited in black robes. Pilate was arrayed in a garb of striped silk, and the apostles, seated round a large table covered with sweetmeats, were carried on the shoulders of Zamboes. At sunset, effigies of Jews in French vestments, and formed of straw and other combustibles, were burnt in the principal streets.

Dreading the insalubrity of the town, the travellers retired on the 6th April to the Indian village of Turbaco, situated in a beautiful district, at the entrance of a large forest, about $17\frac{1}{4}$ miles to the south-west of the Popa, one of the most remarkable summits in the neighbourhood of Carthagena. Here they remained until they made the necessary preparations for their voyage on the Rio Magdalena, and for the long journey which they

CHAP. XXII.

Vegetation.

Agreeable society.

Pageant of the Pascua.

Village of Turbaco

CHAP. XXII. intended to make to Bogota, Popayan, and Quito. The village is about 1151 feet above the level of the sea. Snakes were so numerous that they chased the rats even in the houses, and pursued the bats on the roofs. From the terrace surrounding their habitation they had a view of the colossal mountains of the Sierra Nevada de Santa Marta, part of which was covered with perennial snow. The intervening space, consisting of hills and plains, was adorned with a luxuriant vegetation, resembling that of the Orinoco. There they found gigantic trees, not previously known, such as the *Rhinocarpus excelsa*, with spirally-curved fruit, the *Ocotea turbacensis*, and the *Cavanillesia platanifolia*; the large five-winged fruit of which is suspended from the tips of the branches like paper-lanterns. They botanized every day in the woods from five in the morning till night, though they were excessively annoyed by mosquitoes, zancudoes, xegens, and other tipulary insects. In the midst of these magnificent forests they frequently saw plantations of bananas and maize, to which the Indians are fond of retiring at the end of the rainy season.

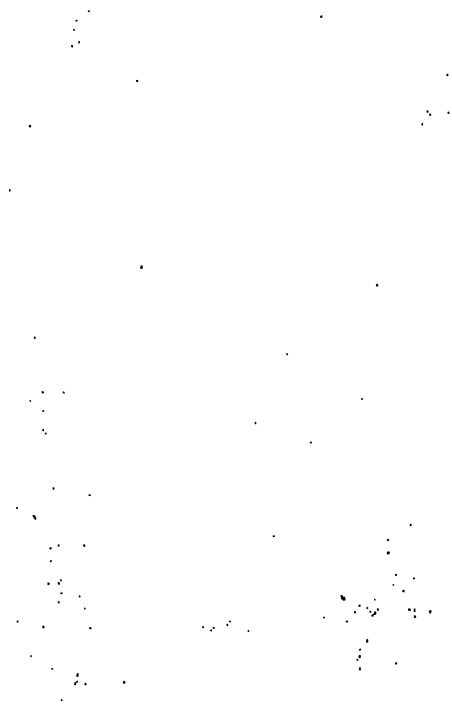
Number of snakes.

Gigantic trees.

Los Volcan-citos.

Petrified corals.

The persons who accompanied the travellers on these expeditions often spoke of a marshy ground situated in the midst of a thicket of palms, and which they designated by the name of Los Volcancitos. They said that, according to a tradition preserved in the village, the ground had formerly been ignited, but that a monk had extinguished it by frequent aspersions of holy water, and converted the fire-volcano into a water-volcano. Without attaching much credit to this tradition, the philosophers desired their guides to lead them to the spot. After traversing a space of about 5300 yards, covered with trunks of *Cavanillesia*, *Piragra superba*, and *Gyrocarpus*, and in which there appeared here and there projections of a limestone rock containing petrified corals, they reached an open place of about 850 feet square, entirely destitute of vegetation, but margined with tufts of *Bromelia karatas*. The surface was composed of layers of clay of a dark-gray colour cracked by desiccation



CHAP. XXII. intende

Number of
snakes.village
Snakes
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Santa M
snow.Gigantic
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corals.of *Bromelia* the surface was composed of
layers of clay of a dark-gray colour cracked by desiccation



THE VOYAGERS OF SUMATRA.

Shaded in the mass of a thicket of palms, and which they descended by the side of Low Yabandak. — Page 27A

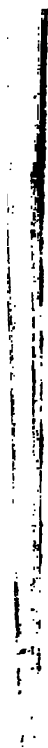


into pentagonal and heptagonal prisms. The volcancitos consist of fifteen or twenty small truncated cones rising in the middle of this area, and having a height of from 19 to 25 feet. The most elevated were on the southern side, and their circumference at the base was from 78 to 85 yards. On climbing to the top of these mud-volcanoes, they found them to be terminated by an aperture from 16 to 30 inches in diameter, filled with water, through which air-bubbles obtained a passage; about five explosions usually taking place in two minutes. The force with which the air rises would lead to the supposition of its being subjected to considerable pressure, and a rather loud noise was heard at intervals, preceding the disengagement of it fifteen or eighteen seconds. Each of the bubbles contained from 12 to 14½ cubic inches of elastic fluid, and their power of expansion was often so great that the water was projected beyond the crater, or flowed over its brim. Some of the openings by which air escaped were situated in the plain without being surrounded by any prominence of the ground. It was observed that when the apertures, which are not placed at the summit of the cones, and are enclosed by a little mud-wall from 10 to 15 inches high, are nearly contiguous, the explosions did not take place at the same time. It would appear that each crater receives the gas by distinct canals, or that these, terminating in the same reservoir of compressed air, oppose greater or less impediments to the passage of the aeriform fluids. The cones have no doubt been raised by these fluids, and the dull sound that precedes the disengagement of them indicates that the ground is hollow. The natives asserted that there had been no observable change in the form and number of the cones for twenty years, and that the little cavities are filled with water even in the driest seasons. The temperature of this liquid was not higher than that of the atmosphere; the latter having been 81·5°, and the former 80·6° or 81°, at the time of Humboldt's visit. A stick could easily be pushed into the apertures to the depth of six

CHAP. XXII.
Mud vol-
canoes.

Air bubbles.

Reception
of gas.



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CHAP. XXII.
Mud vol-
canoes.

Air bubbles.

Reception
of gas.

CHAP. XX

Effect
on combustion.

Botanical
collection.

Life at
Turbaco.

Pleasant
recollections.

Preparation
for further
labour.

or seven feet, and the dark-coloured clay or mud was exceedingly soft. An ignited body was immediately extinguished on being immersed in the gas collected from the bubbles, which was found to be pure azote.

The stay which our travellers made at Turbaco was uncommonly agreeable, and added greatly to their collection of plants. "Even now," says Humboldt, writing in 1831, "after so long a lapse of time, and after returning from the banks of the Obi and the confines of Chinese Zungaria, these bamboo-thickets, that wild luxuriance of vegetation, those orchidæ covering the old trunks of the ocotea and Indian fig, that majestic view of the snowy mountains, that light mist filling the bottom of the valleys at sunrise, those tufts of gigantic trees rising like verdant islets from a sea of vapours, incessantly present themselves to my imagination. At Turbaco we lived a simple and laborious life. We were young; possessed a similarity of taste and disposition; looked forward to the future with hope; were on the eve of a journey which was to lead us to the highest summits of the Andes, and bring us to volcanoes in action in a country continually agitated by earthquakes; and we felt ourselves more happy than at any other period of our distant expedition. The years which have since passed, not all exempt from griefs and pains, have added to the charms of these impressions; and I love to think that, in the midst of his exile in the southern hemisphere, in the solitudes of Paraguay, my unfortunate friend, M. Bonpland, sometimes remembers with delight our botanical excursions at Turbaco, the little spring of Torecillo, the first sight of a *gustavia* in flower, or of the *cavilllesia* loaded with fruits having membranous and transparent edges."

M. Bonpland's health having suffered severely during the navigation of the Orinoco and Casiquiare, they resolved to provide themselves with all the conveniences necessary to secure their comfort during the ascent of the Rio Magdalena. They were accompanied on this voyage by an old French physician M. de Rieux, and

two Spaniards. Leaving Turbaco, in a cool and very dark night they passed through a wood of bamboos rising from forty to fifty feet. At daybreak they reached Arjona on the borders of the forest, crossed an arm of the Río Magdalena in a canoe, and arrived at Mahates, where they had to wait nearly all day for the mules which were to convey their baggage to the place of embarkation. It was excessively hot, without a breath of wind, and, to add to their vexation, their only remaining barometer had been broken in passing the canal; but they consoled themselves by examining some beautiful species of parrots which they obtained from the natives.

On the 20th April, at three in the morning, the air feeling deliciously cool, although the thermometer was at 71.6°, they were on their journey to the village of Barancas Nuevas, amid a forest of lofty trees. Half-way between Mahates and that hamlet they found a group of huts elegantly constructed of bamboos, and inhabited by Zamboes. Humboldt remarks, that the intermixture of Indians and negroes is very common in those countries, and that the women of the American tribes have a great liking to the men of the African race. To the east of Mahates the limestone formation, containing corals, ceases to appear; the predominant rocks being siliceous with argillaceous cement, forming alternating beds of small-grained quartzose and slaty sandstone, or conglomerates containing angular fragments of lydian-stone, clay-slate, gneiss, and quartz, and varying in colour from yellowish-gray to brownish-red.

Hitherto the narrative of the important journey performed by Humboldt and Bonpland, through those little known but highly interesting regions of South America which were visited by them, has been given as much in detail as is consistent with the nature of a work like the present; but here, as no minute account of their further progress has yet been laid before the public, we must cease to follow them step by step, and content ourselves with a brief narrative of their proceedings.

CHAP. XXII.
Arrival at Mahates.

Forest
Journey

Narrative
of the
Journey.

CHAPTER XXIII.

Brief Account of the Journey from Carthagena to Quito and Mexico.

Ascent of the Rio Magdalena—Santa Fe de Bogota—Cataract of Tequendama—Natural Bridges of Icononzo—Passage of Quindiu—Cargueros—Popayan—Quito—Cotopaxi and Chimborazo—Route from Quito to Lima—Guayaquil—Mexico—Guanaxuato—Volcano of Jorullo—Pyramid of Cholula.

CHAP. XXIII. It has been already stated that Humboldt, previously to leaving Paris, had promised Baudin, that should his proposed expedition to the southern hemisphere ever take place, he would endeavour to join it; and also that information received by him at Cuba had induced him to relinquish plans subsequently formed, and re-embark for the continent of South America, with the view of proceeding to Guayaquil or Lima, where he expected to meet the navigators. Accordingly he went to Carthagena, where he learned that the season was too far advanced for sailing from Panama to Guayaquil. Giving up, therefore, his intention of crossing the isthmus of Panama, he passed some days in the forests of Turbaco, and afterwards made preparations for ascending the Rio Magdalena.

Rio Magdalena.

This river, from its sources near the equator, flows almost directly north. "Nature," says a traveller who sailed up it in 1823, "seems to have designedly dug the bed of the Magdalena in the midst of the cordilleras of Colombia, to form a canal of communication between

the mountains and the sea; yet it would have made nothing but an unnavigable torrent, had not its course been stopped in many parts by masses of rock disposed in such a manner as to break its violence. Its waters thus arrested flow gently into the plains of the provinces of Santa Martha and Carthagena, which they fertilize and refresh by their evaporation. Three very distinct temperatures reign on the Magdalena. The sea-breezes blow from its mouth as far as Monpox; from this town to Morales not a breath of air tempers the heat of the atmosphere, and man would become a victim to its power but for the abundant dews which fall during the night; from Morales as far as the sources of the Magdalena, the south wind moderates the heat of the day, and forms the third temperature. These land-breezes cause the navigation of the Magdalena to be rarely fatal to Europeans.* But, according to the same author, multitudes of animals of various species continually harass the traveller. He cannot bathe on account of the caymans, and if he venture on shore he is in danger of being bitten by serpents.

CHAP. XXIII
Changes of
temperature

The voyage up this river, which lasted fifty-five days, was not performed without hazard and inconvenience. Humboldt sketched a chart of it, while his friend was busily occupied in examining the rich and beautiful vegetation of its banks. Disembarking at Honda, they proceeded on mules by dangerous paths, through forests of oaks, melastomæ, and cinchonæ, to Santa Fe de Bogota, the capital of New Grenada. This city stands in a beautiful valley surrounded by lofty mountains, and which would appear to have been at a former period the bed of a great lake. Here the travellers spent several months in exploring the mineralogical and botanical treasures of the country, the magnificent cataract of Tequendama, and the extensive collections of the celebrated Mutis.

Hazardous
voyages.

Santa Fe de
Bogota.

The elevated plain on which this metropolis is built

* Mollien's Travels in Colombia.

THE GREAT RIVERS

THE GREAT RIVERS OF THE AMERICAS

THE GREAT RIVERS OF THE AMERICAS

THE GREAT RIVERS OF THE AMERICAS

THE GREAT RIVERS

This river, from its
lowest directly north
sided up in 1823,
bed of the Magd-
Colombia, to 6



The following is a list of the
 names of the persons who have
 been appointed to the various
 offices of the Society for the
 year 1911. The names are
 arranged in alphabetical order
 of their surnames. The names
 of the persons who have been
 appointed to the offices of
 Secretary and Treasurer are
 printed in italics. The names
 of the persons who have been
 appointed to the offices of
 Librarian and Editor are
 printed in bold type. The
 names of the persons who
 have been appointed to the
 offices of Corresponding
 Secretary and Treasurer are
 printed in small type. The
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 have been appointed to the
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 Editor are printed in bold
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CHAP. XXIII. is 8727 feet above the level of the sea, and is consequently higher than the summit of St Bernard. The river of Funza, usually called Rio de Bogota, which drains the valley, has forced its way through the mountains to the south-west of Santa Fe, and near the farm of Tequendama rushes from the plain by a narrow outlet into a crevice, which descends towards the bed of the Rio Magdalena. Respecting this ravine, Gonzalo Ximenes de Quesada, the conqueror of the country, found the following tradition disseminated among the people:—In remote times the inhabitants of Bogota were barbarians, living without religion, laws, or arts. An old man on a certain occasion suddenly appeared among them, of a race unlike that of the natives, and having a long bushy beard. He instructed them in the arts; but he brought with him a very malignant, although very beautiful woman, who thwarted all his benevolent enterprises. By her magical power she swelled the current of the Funza, and inundated the valley; so that most of the inhabitants perished, a few only having found refuge in the neighbouring mountains. The aged visiter then drove his consort from the earth, and she became the moon. He next broke the rocks that enclosed the valley on the Tequendama side, and by this means drained off the waters; then he introduced the worship of the sun, appointed two chiefs, and finally withdrew to a valley, where he lived in the exercise of the most austere penitence during 2000 years.

Elevated site.

Native tradition.

Cataract of Tequendama. The cataract of Tequendama presents an assemblage of all that is picturesque. The river a little above it is 144 feet in breadth, but at the crevice narrows to a width of not more than 12 yards. The height of the fall, which forms a double bound, is 574 feet, and the column of vapour that rises from it is visible from Santa Fe at the distance of 17 miles. The vegetation at the foot of the precipice has a totally different appearance from that at the summit; and while the spectator leaves behind him a plain in which the cereal plants of Europe are cultivated, and sees around him oaks, elms, and

other trees resembling those of the temperate regions of the northern hemisphere, he looks down upon a country covered with palms, bananas, and sugar-canes. CHAP. XXIII

Leaving Santa Fe, in September 1801, the travellers passed the natural bridges of Icononzo, formed by masses of rock lying across a ravine of immense profundity. The valleys of the cordilleras are generally crevices, the depth of which is often so great, that were Vesuvius seated in them its summit would not exceed that of the nearest mountains. One of these, that, namely, of Icononzo or Pandi, is peculiarly remarkable for the singular form of its rocks, the naked tops of which present the most picturesque contrast with the tufts of trees and shrubs which cover the edges of the gulf. A torrent, named the Summa Paz, forms two beautiful cascades where it enters the chasm, and where it again escapes from it. A natural arch $47\frac{1}{2}$ feet in length and 39 in breadth, stretches across the fissure at a height of 318 feet above the stream. Sixty-four feet below this bridge is a second, composed of three enormous masses of rock which have fallen so as to support each other. In the middle of it is a hole through which the bottom of the cleft is seen. The torrent, viewed from this place, seemed to flow through a dark cavern, whence arose a doleful sound, emitted by the nocturnal birds that haunt the abyss, thousands of which were seen flying over the surface of the water, supposed by Humboldt from their appearance to be goatsuckers.

Natural
bridges of
Icononzo.

Cascades.

In the kingdom of New Grenada, from $2^{\circ} 30'$ to $5^{\circ} 15'$ of north latitude, the cordillera of the Andes is divided into three parallel chains. The eastern one separates the valley of the Rio Magdalena from the plains of the Rio Meta, and on its western declivity are the natural bridges of Icononzo above mentioned. The central chain, which parts the waters between the basin of the Rio Magdalena and that of the Rio Cauca, often attains the limits of perpetual snow, and shoots far beyond it in the colossal summits of Guanacas, Baragan, and Quindiu. The western ridge cuts off the valley of Cauca from the

Cordilleras of
the Andes.

CHAP. XXIII

Descent of
the eastern
chain.

province of Choco and the shores of the South Sea. In passing from Santa Fe to Popayan and the banks of the river now mentioned, the traveller has to descend the eastern chain, either by the Mesa and Tocayma or the bridges of Icononzo, traverse the valley of the Rio Magdalena, and cross the central chain, as Humboldt did, by the mountain of Quindiu.

Mountain
forest.

This mountain, which is considered as the most difficult passage in the cordilleras, presents a thick uninhabited forest, which, in the finest season, cannot be passed in less than ten or twelve days. Travellers usually furnish themselves with a month's provision, as it often happens that the melting of the snow, and the sudden floods arising from it, prevent them from descending. The highest point of the road is 11,499½ feet above the level of the sea, and the path, which is very narrow, has in several places the appearance of a gallery dug in the rock and left open above. The oxen, which are the beasts of burden commonly used in the country, can scarcely force their way through these passages, some of which are 6562 feet in length. The rock is covered with a thick layer of clay, and the numerous gullies formed by the torrents are filled with mud.

Deluge of
rain.

In crossing this mountain the philosophers, followed by twelve oxen carrying their collections and instruments, were deluged with rain. Their shoes were torn by the prickles which shoot out from the roots of the bamboos, so that, unwilling to be carried on men's backs, they were obliged to walk barefooted. The usual mode of travelling, however, is in a chair tied to the back of a carguero or porter. When one reflects on the enormous fatigue to which these bearers are exposed, he is at a loss to conceive how the employment should be so eagerly embraced by all the robust young men who live at the foot of the Andes. The passage of Quindiu is not the only part of South America which is traversed in this manner. The whole province of Antioquia is surrounded by mountains so difficult to be crossed, that those who refuse to trust themselves to the skill of a carguero,

Great
fatigue.

and are not strong enough to travel on foot, must relinquish all thoughts of leaving the country. The number of persons who follow this laborious occupation, at Choco, Hague, and Medellin, is so great that our travellers sometimes met a file of fifty or sixty. Near the mines of Mexico there are also individuals who have no other employment than that of carrying men on their backs.

CHAP. XXIII.
Mode of
travelling.

The cargueros, in crossing the forests of Quindiu, take with them bundles of the large oval leaves of the vijao, a plant of the banana family, the peculiar varnish of which enables them to resist rain. A hundredweight of these leaves is sufficient to cover a hut large enough to hold six or eight persons. When they come to a convenient spot where they intend to pass the night, the carriers lop a few branches from the trees, with which they construct a frame; it is then divided into squares by the stalks of some climbing plant, or threads of agave, on which are hung the vijao leaves, by means of a cut made in their midrib. In one of these tents, which are cool, commodious, and perfectly dry, our travellers passed several days in the valley of Boquia, amidst violent and incessant rains.

Cargueros.

From these mountains, where the truncated cone of Tolima, covered with perennial snow, rises amidst forests of styrax, arborescent passifloræ, bamboos, and wax-palms, they descended into the valley of Cauca towards the west. After resting some time at Carthago and Buga, they coasted the province of Choco, where platina is found among rolled fragments of basalt, greenstone and fossil wood.

Valley of
Cauca.

They then went up by Caloto and the mines of Quilichao to Popayan, which is situated at the base of the snowy mountains of Purace and Sotara. This city, the capital of New Grenada, stands in the beautiful valley of the Rio Cauca, at an elevation of 5906 feet above the sea, and enjoys a delicious climate. On the ascent from Popayan towards the summit of the volcano of Purace, at a height of 8694 feet, is a small plain inhabited by Indians, and cultivated with the greatest care. It is

Caloto.

CHAP. XXIII. bounded by two ravines, on the brink of which is placed a village of the same name. The gardens, which are enclosed with hedges of euphorbium, are watered by the springs that issue abundantly from the porphyritic rock; and nothing can be more agreeable than the contrast between the beautiful verdure of this plain and the chain of dark mountains surrounding the volcano. The hamlet of Purace, which the travellers visited in November 1801, is celebrated for the fine cataracts of the Rio Vinagre, the waters of which are acid. This little river is warm towards its source, and after forming three falls, one of which is 394 feet in height and is exceedingly picturesque, joins the Rio Cauca, which for fourteen miles below the junction is destitute of fish. The crater of the volcano is filled with boiling water, which, amid frightful noises, emits vapours of sulphuretted hydrogen.

Valley of
Patia.

The travellers then crossed the precipitous cordilleras of Almaquer to Pasto, avoiding the infected and contagious atmosphere of the valley of Patia. From the latter town, which is situated at the foot of a burning volcano, they traversed the elevated platform of the province of Los Pastos, celebrated for its great fertility; and after a journey of four months, performed on mules, arrived at Quito on the 6th January 1802.

Climate.

The climate of this province is remarkably agreeable, and almost invariable. During the months of December, January, February, and March, it generally rains every afternoon from half-past one to five; but even at this season the evenings and mornings are most beautiful. The temperature is so mild that vegetation never ceases. "From the terrace of the government palace there is one of the most enchanting prospects that human eye ever witnessed, or nature ever exhibited. Looking to the south, and glancing along towards the north, eleven mountains covered with perpetual snow present themselves, their bases apparently resting on the verdant hills that surround the city, and their heads piercing the blue arch of heaven, while the clouds hover midway down them, or seem to crouch at their feet. Among

these the most lofty are Cayambeurcu, Imbaburu, Ilinisa, Antisana, Chimborazo, and the beautifully magnificent Cotopaxi, crowned with its volcano.”* CHAP. XXIII

Nearly six months were devoted to researches of various kinds. They made excursions to the snowy mountains of Antisana, Cotopaxi, Tunguragua, and Chimborazo, the latter of which was considered as the highest on the globe until it was found to be exceeded by some of the colossal summits of the Himmaleh, and even by several in Upper Peru. In all these journeys they were accompanied by a young man, son of the Marquis of Selva-alègre, who subsequently followed them to Peru and Mexico.† They twice ascended to the volcanic summit of Pichincha, where they made experiments on the constitution of the air,—its elasticity, its electrical, magnetic, and hygroscopic qualities,—and the temperature of boiling water. Varied
researches.

Cotopaxi is the loftiest of those volcanoes of the Andes which have produced eruptions at recent periods; its absolute height being 18,878 feet. It is consequently 2625 feet higher than Vesuvius would be were it placed on the top of the Peak of Teneriffe. The scorïæ and rocks ejected by it, and scattered over the neighbouring valleys, would form a vast mountain of themselves. In 1738 its flames rose 2953 feet above the crater; and in 1744 its roarings were heard as far as Honda, on the Magdalena, at a distance of 690 miles. On the 4th April 1768, the quantity of ashes thrown out was so great, that in the towns of Hambato and Tacunga the inhabitants were obliged to use lanterns in the streets. Volcano of
Cotopaxi.

The explosion which took place in January 1803 was preceded by the sudden melting of the snows which Eruption.

* Stevenson's *Residence in South America*, vol. ii. p. 324.

† This accomplished individual, Don Carlos Montufar, of whom our author speaks with approbation, having connected himself with the popular party in the struggles of which the Spanish colonies have lately been the theatre, was seized in Quito, in 1811, by Don Tarbio Montes, sentenced as a traitor, and shot through the back; after which his heart was taken out and burnt.—See *Stevenson's Residence in South America*, vol. iii. p. 44.

CHAP. XXIII. covered the surface ; and our travellers, at the port of Guayaquil, 179 $\frac{1}{2}$ miles distant, heard day and night the noises proceeding from it, like discharges of a battery.

Form and position.

This celebrated mountain is situated to the south-east of Quito, at the distance of 41 miles, in the midst of the Andes. Its form is the most beautiful and regular of all the colossal summits of that mighty chain ; being a perfect cone, which is covered with snow, and shines with dazzling splendour at sunset. No rocks project through the icy covering, except near the edge of the crater, which is surrounded by a small circular wall. In ascending it is extremely difficult to reach the lower boundary of the snows, the cone being surrounded by deep ravines ; and, after a near examination of the summit, Humboldt thinks he may assert that it would be altogether impossible to reach the brink of the crater.

Chains of the Andes.

It was mentioned that, in the kingdom of New Grenada, the cordilleras of the Andes form three chains, in the great longitudinal valleys of which flow two arge rivers. To the south of Popayan, on the table-land of Los Pastos, these three chains unite into a single group, which stretches far beyond the equator. This group, in the kingdom of Quito, presents an extraordinary appearance from the river of Chota, the most elevated summits being arranged in two lines, forming as it were a double ridge to the cordilleras. These summits served for signals to the French academicians when employed in the measurement of an equinoctial degree. Bouguer considered them as two chains, separated by a longitudinal valley ; but this valley Humboldt views as the ridge of the Andes itself. It is an elevated plain, from 8858 to 9515 feet above the level of the sea ; and the volcanic summits of Pichincha, Cayambo, Cotopaxi, and other celebrated peaks, are, he thinks, so many protuberances of the great mass of the Andes. In consequence of the elevation of the territory of Quito, these mountains do not seem so high as many of much inferior altitude rising from a lower basis.

Remarkable appearance.

On Chimborazo the line marking the inferior limit of

perpetual snow is at a height somewhat exceeding that of Mont Blanc. On a narrow ledge, which rises amidst the snows on the southern declivity, our travellers attempted on the 23d June to reach the summit. The point where they stopped to observe the inclination of the magnetic meridian was more elevated than any yet attained by man, being 3609 feet higher than the summit of Mont Blanc, and more than 3714 feet higher than La Condamine and Bouguer reached in 1745 on the Corazon. The ridge to which they climbed, and beyond which they were prevented from proceeding by a deep chasm in the snow, was 19,798 feet above the level of the sea; but the summit of the mountain was still 1439 feet higher. The blood issued from their eyes, lips, and gums. The form of Chimborazo is conical, but the top is not truncated like that of Cotopaxi, being rounded or semicircular in outline.

While at Quito, Humboldt received a letter from the National Institute of France, by which he was apprized that Captain Baudin had set out for New Holland by the Cape of Good Hope. He was obliged therefore to renounce all thoughts of joining the expedition, although the hope of being able to meet it had induced him to relinquish his plan of proceeding from Cuba to Mexico and the Philippine Islands, and had led him upwards of 3452 miles southward. The travellers, however, consoled themselves with the thought of having examined regions over which the eye of science had never before glanced; and, resolving henceforth to trust solely to their own resources, after spending some months in exploring the Andes, they set out in the direction of Lima.

They first pointed their course to the great River Amazon, visiting the ruins of Lactacunga, Hambato, and Riobamba, in a country the face of which was entirely changed by the frightful earthquakes of 1797, that destroyed nearly 40,000 of the inhabitants. They then with great difficulty passed to Loxa, where in the forests of Gonzanama and Malacates they examined the

CHAP. XXIII.

Line of perpetual snow.

Course pursued by Baudin.

Course of Journey.

CHAP. XXIII. trees which yield the Peruvian bark. The vast extent of ground which they traversed in the course of their expedition afforded them better opportunities than any botanist had ever enjoyed of comparing the different species of Cinchona.

Peru. Leaving Loxa they entered Peru by Ayavaca and Guancabamba, traversing the ridge of the Andes to descend to the River Amazon. In two days they had to cross twenty-seven times the Rio de Chayma. They saw the magnificent remains of the causeway of the Incas, which traversed the porphyritic summits from Cusco to Assouay, at a height varying from 7670 to 11,610 feet. At the village of Chaymaya, on a river of the same name, they took ship and descended to the Amazon.

Geographical observations. La Condamine, on his return from Quito to Para, embarked on this river only below Quebrada de Chunchunga; and Humboldt, with the view of completing the map made by the French astronomer, proceeded as far as the cataracts of Rentama. At Tomependa, the principal place of the province of Jaen de Bracamorros, he constructed a map of the Upper Amazon, from his own observations as well as from accounts received from the natives. Bonpland employed himself, as usual, in examining the subjects of the vegetable kingdom, among which he discovered several new species of Cinchona.

Position of the magnetic equator. Returning to Peru, our travellers crossed the cordillera of the Andes the fifth time. In seven degrees of south latitude they determined the position of the magnetic equator, or the line in which the needle has no inclination. They also examined the mines of Gualgayoc, where large masses of native silver are found at an elevation of 11,613 feet above the sea, and which, together with those of Pasco and Huantajayo, are the richest in Peru. From Caxamarca, celebrated for its hot-springs and the ruins of the palace of Atahualpa, they went down to Truxillo. In this neighbourhood are the remains of the ancient Peruvian city Mansiche

adorned by pyramids, in one of which an immense quantity of gold was discovered in the eighteenth century. Descending the western slope of the Andes they beheld for the first time the Pacific Ocean, and the long narrow valley bounded by its shores, in which rain and thunder are unknown. From Truxillo they followed the arid coast of the South Sea, and arrived at Lima, where they remained several months. At the port of Callao, Humboldt had the satisfaction of observing the transit of Mercury, although the thick fog which prevails there sometimes obscures the sun for many days in succession.

CHAP. XXIII.
Ancient
Mansicha.

In January 1803 the travellers embarked for Guayaquil, in the vicinity of which they found a splendid forest of palms, plumeriæ, tabernæ-montanæ, and scitamineæ. Here also they heard the incessant noises of the volcano of Cotopaxi, which had experienced a tremendous agitation on the 6th January. From Guayaquil they proceeded by sea to Acapulco in New Spain. At first, Humboldt's intention was to remain only a few months in Mexico, and return as speedily as possible to Europe, more especially as his instruments, and in particular the chronometers, were getting out of order while he found it impossible to procure others. But the attractions of so beautiful and diversified a country, the great hospitality of its inhabitants, and the dread of the yellow fever of Vera Cruz, which usually attacks those who descend from the mountains between June and October, induced him to remain until the middle of winter.

Guayaquil.

Hospitable
treatment.

After making numerous observations and experiments on the atmospherical phenomena, the horary variations of the barometer, magnetism, and the natural productions of the country, our travellers set out in the direction of Mexico; gradually ascending by the burning valleys of Mescala and Papagayo, where the thermometer rose to 89·6° in the shade, and where the river is crossed on fruits of *Crescentia pinnata*, attached to each other by ropes of agave. Reaching the elevated plains of Chil-

Observations
and experi-
ments.

CHAP. XXIII. pansingo, Tehuilotepec, and Tasco, which are situated at a height varying from 3500 to 5900 feet above the sea, they entered a region blessed with a temperate climate, and producing oaks, cypresses, pines, tree-ferns, and the cultivated cereal plants of Europe. After visiting the silver-mines of Tasco, the oldest and formerly the richest of Mexico, they went up by Cuernavaca and Guachilaco to the capital. Here they spent some time in the agreeable occupation of examining numerous curiosities, antiquities, and institutions, in making astronomical observations, in studying the natural productions of the surrounding country, and in enjoying the society of enlightened individuals. The longitude of Mexico, which had been misplaced two degrees on the latest maps, was accurately determined by a long series of observations.

Elevated
plains.

Mexico.

Ancient
mines.

Our travellers next visited the celebrated mines of Moran and Real del Monte, and examined the obsidians of Oyamel, which form layers in pearlstone and porphyry, and were employed by the ancient Mexicans for the manufacture of knives. The cascade of Regla, a representation of which forms the vignette to the present volume, is situated in the neighbourhood. The regularity of the basaltic columns is as remarkable as that of the deposits of Staffa. Most of them are perpendicular, though some are horizontal, and others have various degrees of inclination. They rest upon a bed of clay, beneath which basalt again occurs. Returning from this excursion in July 1803, they made another to the northern part of the kingdom, in the course of which they inspected the aperture made in the mountain of Suicog for the purpose of draining the valley of Mexico. They next passed by Queretaro, Salamanca, and the fertile plains of Yrapuato, on the way to Guanaxuato, a large city placed in a narrow defile, and celebrated for its mines.

Abode at
Guanaxuato.

There they remained two months, making researches into the geology and botany of the neighbouring country. From thence they proceeded by the valley of San Jago to Valladolid, the capital of the ancient kingdom of

Mechoacan; and, notwithstanding a continuance of heavy autumnal rains, descended by Patzquaro, which is situated on the edge of an extensive lake towards the shores of the Pacific Ocean, to the plains of Jorullo. Here they entered the great crater, making their way over crevices exhaling ignited sulphuretted hydrogen, and experiencing much danger from the brittleness of the lava.

CHAP. XXIII.
Autumnal
rains.

The formation of this volcano is one of the most extraordinary phenomena which have been observed on our globe. The plain of Malpais, covered with small cones from six to ten feet in height, is part of an elevated table-land bounded by hills of basalt, trachyte, and volcanic tufa. From the period of the discovery of America to the middle of the last century, this district had undergone no change of surface, and the seat of the crater was then covered with a plantation of indigo and sugar-cane; when, in June 1759, hollow sounds were heard, and a succession of earthquakes continued for two months, to the great consternation of the inhabitants. From the beginning of September every thing seemed to announce the re-establishment of tranquillity; but in the night of the 28th the frightful subterranean noises again commenced. The Indians fled to the neighbouring mountains. A tract not less than from three to four square miles in extent rose up in the shape of a dome; and those who witnessed the phenomenon asserted, that flames were seen issuing from a space of more than six square miles, while fragments of burning rocks were projected to an immense height, and the surface of the ground undulated like an agitated sea. Two brooks which watered the plantations precipitated themselves into the burning chasms. Thousands of the small cones described above suddenly appeared, and in the midst of these eminences, called hornitos or ovens, six great masses, having an elevation of from 1312 to 1640 feet above the original level of the plain, sprung up from a gulf running from N.N.E. to S.S.W. The most elevated of these mounds is the great volcano of Jorullo, which is con-

Volcano.

Volcanic
action.

CHAP. XXIII continually burning. The eruptions of this central volcano continued till February 1760, when they became less frequent. The Indians, who had abandoned all the villages within thirty miles of it, returned once more to their cottages, and advanced towards the mountains of Aguasarco and Santa Ines, to contemplate the streams of fire that issued from the numberless apertures. The roofs of the houses of Queretaro, more than 166 miles distant, were covered with volcanic dust. Mr Lyell (*Principles of Geology*, vol. i. p. 379) states, on the authority of Captain Vetch, that another eruption happened in 1819, accompanied by an earthquake, during which ashes fell at the city of Guanaxuato, 140 miles distant from Jorullo, in such quantities as to lie six inches deep in the streets.*

Rise of the thermometer.

When Humboldt visited this place, the natives assured him that the heat of the hornitos had formerly been much greater. The thermometer rose to 203° when placed in the fissures exhaling aqueous vapour. Each of the cones emitted a thick smoke, and in many of them a subterranean noise was heard, which seemed to indicate the proximity of a fluid in ebullition. Two streams were at that period seen bursting through the argillaceous vaults, and were found by the traveller to have a temperature of 126·9°. The Indians gave them the names of the two rivers which had been engulfed, because in several parts of the Malpais great masses of water are heard flowing in a direction from east to west. Our author considers all the district to be hollow; but Scrope and Lyell find it more suitable to their views of volcanic agency to represent the conical form of the

Rivers engulfed.

* In the fourth edition (Lond. 1835) of his *Principles*, Mr Lyell says, that there appears to have been some mistake in this statement; for Mr Burkart, who examined Jorullo in 1827, ascertained that there had been no eruption there since Humboldt's visit in 1803. There was still a slight evolution of sulphurous acid vapours from the bottom of the crater; but the "hornitos" had ceased to send forth steam, and vegetation had made great progress on the flanks of the new hills, the rich soil of the surrounding country being once more covered with luxuriant crops of sugar-cane and indigo.



1998





Costumes of the Indians of Mechoacan.

ground as resulting from the flow of lava over the original surface of the plain.

The Indians of this province are represented as being the most industrious of New Spain. They have a considerable talent for cutting out images in wood, and dressing them in clothes made of the pith of an aquatic plant, which being very porous imbibes the most vivid colours. Two figures of this kind, which Humboldt brought home for the Queen of Prussia, are here represented. They exhibit the characteristic traits of the American race, together with a strange mixture of the ancient costume with that which was introduced by the Spaniards.

From Valladolid, the ancient kingdom of Mechoacan, the travellers returned to Mexico by the elevated plain of Toluca, after examining the volcanic mountains in the vicinity. They also visited the celebrated cheiranthostæmon of Cervantes, a tree of which it was at one

Return to
Mexico.

CHAP. XXIII. time supposed there did not exist more than a single specimen.

Residence at Mexico.

At that city they remained several months, for the purpose of arranging their botanical and geological collections, calculating the barometrical and trigonometrical measurements which they had made, and sketching the plates of the Geological Atlas which Humboldt proposed to publish. They also assisted in placing a colossal equestrian statue of the king, which had been cast by a native artist. In January 1804 they left Mexico with the intention of examining the eastern declivity of the cordillera of New Spain. They also measured the great

Pyramid of Cholula.

pyramid of Cholula, an extraordinary monument of the Toltecks, from the summit of which there is a splendid view of the snowy mountains and beautiful plains of Tlascalala. It is built of brick, which seemed to have been dried in the sun, alternating with layers of clay. They then descended to Xalapa, a city placed at an elevation of 4335 feet above the sea, in a delightful climate. The dangerous road which leads from it to Perote, through almost impenetrable forests, was thrice barometrically levelled by Humboldt. Near the latter place is a mountain of basaltic porphyry, remarkable for the singular form of a small rock placed on its summit, and which is named the Coffe of Perote. This elevation commands

The Coffe of Perote.

a very extensive prospect over the plain of Puebla and the eastern slope of the cordilleras of Mexico, which is covered with dense forests. From it they also saw the harbour of Vera Cruz, the castle of St Juan of Ulloa, and the seacoast.

Before following our travellers across the Atlantic, it may be useful to present a sketch of the valuable observations recorded in Humboldt's Political Essay on the Kingdom of New Spain, and which are in part the result of his researches in that interesting country.

CHAPTER XXIV.

Description of New Spain or Mexico.

General Description of New Spain or Mexico—Cordilleras—Climates—Mines—Rivers—Lakes—Soil—Volcanoes—Harbours—Population—Provinces—Valley of Mexico, and Description of the Capital—Inundations, and Works undertaken for the Purpose of preventing them.

PREVIOUS to Humboldt's visit to New Spain, the information possessed in Europe respecting that interesting and important country was exceedingly meagre and incorrect. The ignorance of the European conquerors, the indolence of their successors, the narrow policy of the government, and the want of scientific enterprise among the Creoles and Spaniards, left it for centuries a region of dim obscurity into which the eye of research was unable to penetrate. So inaccurate were the maps, that even the latitude and longitude of the capital remained unfixed, and the inhabitants were thrown into consternation by the occurrence of a total eclipse of the sun on the 21st February 1803; the almanacks, calculating from a false indication of the meridian, having announced it as scarcely visible. The determination of the geographical position of many of the more remarkable places, that of the altitude of the volcanic summits and other eminences, together with the vast mass of intelligence contained in the Political Essay on New Spain, served to dispel in some measure the darkness; and since the period of Humboldt's visit numerous travellers

CHAP. XXIV.

Previous
knowledge of
New Spain.

CHAP. XXIV. have contributed so materially to our acquaintance with Mexico, that it no longer remains among the least known of those remote countries of the globe over which the power of Europe has extended.

Political
changes.

Although the independence of the American states has now been confirmed, and their political relations entirely changed since the time our author was there, the aspect of nature continues the same in those extensive regions; and, as we have less to do with their history and national circumstances than with the discoveries of the learned traveller, we shall follow, as heretofore, his descriptions of the countries examined by him in the relations in which they then stood.

Spanish
settlements.

The Spanish settlements in the New Continent formerly occupied that immense territory comprised between $41^{\circ} 43'$ of south latitude and $37^{\circ} 48'$ of north latitude, equalling the whole length of Africa, and exceeding the vast regions possessed by the Russian empire or Great Britain in Asia. They were divided into nine great governments, of which five, viz. the viceroyalties of Peru and New Grenada, the capitanias-generales of Guatimala, Porto Rico, and Caraccas, are entirely inter-tropical; while the other four, viz. the viceroyalties of Mexico and Buenos Ayres, and the capitanias-generales of Chili and Havannah, including the Floridas, are chiefly situated in the temperate zones. Mexico was the most important as well as the most civilized of the whole, and was long considered as such by the court of Madrid.

Govern-
ments.

New Spain.

The name of New Spain was at first given in 1518 to the province of Yucatan, where the companions of Grijalva were astonished at the civilisation of the inhabitants. Cortez employed it to denote the whole empire of Montezuma, though it was subsequently used in various senses. Humboldt designates by it the vast country which has for its northern and southern limits the parallels of 38° and 16° . The length of this region from S.S.E. to N.N.W. is nearly 1678 miles; its greatest breadth 994 miles. The isthmus of Tehuantepec, to the

south-east of the port of Vera Cruz, is the narrowest part ; CHAP. XXIV.
 the distance from the Atlantic Ocean to the South Sea being there only 155 miles. The question of opening a communication by a canal between the two oceans at this point, the isthmus of Panama, or several others which he mentions, is fully discussed by the author. He discredits the idea that the level of the South Sea is higher than that of the Gulf of Mexico, and imagines that were a rupture of the intervening barrier effected, the current would establish itself in the direction opposite to that usually apprehended.

When a general view is taken of the whole surface of Mexico, it is seen that one-half is situated within the tropic, while the rest belongs to the temperate zone. This latter portion contains 716,100 square miles. The physical climate of a country does not altogether depend upon its distance from the pole, but also upon its elevation, its proximity to the ocean, and other circumstances ; so that of the 596,750 square miles in the torrid zone, more than three-fifths have a cold, or at least temperate atmosphere. The whole interior of Mexico, in fact, constitutes an immense table-land, having an elevation which varies from 6562 to 8202 feet above the level of the sea.

The chain of mountains which forms this vast plain is continuous with the Andes of South America. In the southern hemisphere the cordillera is every where broken up by fissures or valleys of small breadth ; but in Mexico it is the ridge itself that constitutes the platform. In Peru the most elevated summits form the crest of the Andes, while in the other the prominences are irregularly scattered over the plain, and have no relation or parallelism to the direction of the cordillera. In Peru and New Grenada there are transverse valleys, having sometimes 4590 feet of perpendicular depth, which entirely prevent the use of carriages ; while in New Spain vehicles are used along an extent of more than 1726 miles. The general height of the table-land of Mexico is equal to that of Mount Ceniz, St Gothard, or the Great

CHAP. XXIV. **St Bernard of the Swiss Alps**; and to determine this circumstance Humboldt executed five laborious barometrical surveys, which enabled him to construct a series of vertical sections of the country.

General elevation.

Plains of South America.

In South America the cordillera of the Andes presents plains completely level at immense altitudes, such as that on which the city of Santa Fe de Bogota stands, that of Caxamarca in Peru, and those of Antisana, which exceed in height the summit of the Peak of Teneriffe. But all these levels are of small extent, and being separated by deep valleys are of difficult access. In Mexico, on the other hand, vast tracts of champaign country are so approximated to each other as to form but a single plain occupying the elongated ridge of the cordillera, and running from the 18th to the 40th degree of north latitude. The descent towards the coasts is by a graduated series of terraces, which oppose great difficulties to the communication between the maritime districts and the interior, presenting at the same time an extraordinary diversity of vegetation.

Climate along the coasts.

The plains along the coasts are the only parts that possess a climate adapted to the productions of the West Indies,—the mean temperature of those situated within the tropics, and whose elevation does not exceed 984 feet, being from 77° to 78·8°, which is several degrees greater than the mean temperature of Naples. These fertile regions, which produce sugar, indigo, cotton, and bananas, are named *Tierras calientes*. Europeans remaining in them for any considerable time, particularly in the towns, are liable to the yellow fever or black vomiting. On the eastern shores the great heats are occasionally tempered by strata of refrigerated air brought from the north by the impetuous winds that blow from October to March, which frequently cool the atmosphere to such a degree, that at Havannah the thermometer descends to 32°, and at Vera Cruz to 60·8°.

On the declivities of the cordillera, at the elevation of 3937 or 4921 feet, there prevails a mild climate, never

varying more than eight or nine degrees. To this region, of which the mean annual temperature is from 68° to 69·8°, the natives give the name of *Tierras templadas*. Unfortunately these tracts are frequently covered with thick fogs, as they occupy the height to which the clouds usually ascend above the level of the sea.

CHAP. XXIV.

Tierras
templadas.

The plains which are elevated more than 7218 feet above that level, and of which the mean temperature is under 62·6°, are named *Tierras frias*. The whole table-land of Mexico belongs to this description, which the natives consider cold, although the ordinary warmth is equal to that of Rome. There are plains of still greater elevation, on which, although they have a mean temperature of from 51·8° to 55·4°, equal to that of France and Lombardy, the vegetation is less vigorous, and European plants do not thrive so well as in their native soil. The winters there are not extremely severe, but in summer the sun has not sufficient power over the rarified air to bring fruits to perfect maturity.

Tierras frias.

From the peculiar circumstances of New Spain, as here sketched, the influence of geographical position upon the vegetation is much less than that of the height of the ground above the sea. In the nineteenth and twentieth degrees of latitude, sugar, cotton, cacao, and indigo, are produced abundantly only at an elevation of from 1968 to 2625 feet. Wheat thrives on the declivities of the mountains, along a zone which commences at 4593 feet and ends at 9843. The banana (*Musa paradisiaca*), on the fruit of which the inhabitants of the tropics chiefly subsist, is seldom productive above 5085 feet; oaks grow only between 2625 and 9843 feet; and pines never descend lower than 6069, nor rise above 13,124 feet.

Influence on
vegetation.

The internal provinces of the temperate zone enjoy a climate essentially different from that of the same parallels in the Old Continent. So remarkable an inequality prevails indeed between the temperature of the seasons, that while the winters resemble those of Ger-

Difference of
climate.

CHAP. XXIV. many, the summers are like those of Sicily. A similar difference exists between the other parts of America and the corresponding latitudes in Europe; but it is less perceptible on the western than on the eastern coasts.

Summer.

Silver mines. New Spain possesses a peculiar advantage in the circumstances under which the precious metals have been deposited. In Peru the most important silver mines, those of Potosi, Pasco, and Chota, are placed at an immense elevation; so that, in working them, men, provisions, and cattle, must be brought from a distance; but in Mexico, the richest of these, those, namely, of Guanaxuato, Zacatecas, Tasco, and Real del Monte, are at moderate heights, and surrounded by cultivated fields, towns, and villages.

Rivers.

There are few rivers of consequence in the country, the Rio Bravo del Norte and the Rio Colorado being the only ones of any magnitude. The former has a course of 1768 miles, the latter of 863; but these streams flow in the least cultivated parts of the country, and can have little influence in a commercial point of view until colonization shall extend to their shores. In the whole equinoctial part of New Spain there are only small rivulets, of which very few can ever become interesting to the merchant.

Lakes.

The numerous lakes, the greater part of which appear to be annually decreasing in size, are the remains of immense basins of water that formerly existed on the elevated plains. Of these may be mentioned the lake of Chapala, nearly 1910 square miles in extent; those of the valley of Mexico, which comprehend a fourth part of its surface; that of Patzcuaro in Valladolid; and, finally, the lakes of Mexitlan and Parras in New Biscay.

Interior table land.

The interior of New Spain, and especially a great part of the elevated table-land of Anahuac, is arid and destitute of vegetation; which arises from the rapid evaporation in high plains, and the circumstance that few of the mountains enter the region of perpetual snow, which under the equator commences at the

height of 15,748 feet, and in the 45th degree of latitude at that of 8366 feet. In Mexico, in the 19th and 20th degrees, perpetual frost commences, according to Humboldt's measurements, at 15,002 feet of elevation; so that of the six colossal summits, which are placed in the same line in the 19th parallel of latitude, only four, namely, the Peak of Orizaba, Popocatepetl, Iztaccihuatl, and Nevado de Toluca, are clothed with perennial snow; while the Cofre de Perote and the Volcan de Colima remain uncovered during the greater part of the year. None of the other mountains rise into so lofty a region.

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Elevation of
perpetual
frost

In general, in the equinoctial part of New Spain, the soil, climate, and vegetation, present a similar character to those of the temperate zone. Although the tablelands are singularly cold in winter, the temperature is much higher in summer than in the Andes of Peru, because the great mass of the cordillera of Mexico, and the vast extent of its plains, produce a reverberation of the sun's rays never observed in elevated countries of greater inequality.

Temperature
of the table
land.

To the north of 20° the rains, which fall only in June, July, August, and September, very seldom extend to the interior. The mountains, being composed of porous amygdaloid and fissured porphyries, present few springs; the filtrated water losing itself in the crevices opened by ancient volcanic eruptions, and issuing at the bottom of the cordilleras.

Rains.

The aridity of the central plain, on which there is a great deficiency of wood, is prejudicial to the working of the mines; and this natural evil has been augmented since the arrival of Europeans, who have not only destroyed the trees without planting others, but have drained a large extent of ground, and thus increased the saline efflorescences which cover the surface and are hostile to cultivation. This dryness, however, is confined to the more elevated plains; and the declivities of the cordillera being exposed to humid winds and fogs, their vegetation is uncommonly vigorous.

Destruction
of trees.

CHAP. XXIV. Mexico is less disturbed by earthquakes than Quito, Guatemala, and Cumana, although these destructive commotions are by no means rare on the western coasts, and in the neighbourhood of the capital, where, however, they are never so violent as in other parts of America. There are only five active volcanoes in all New Spain : Orizaba, Popocatepetl, Tustla, Jorullo, and Colima.

Advantage-
ous situation.

The physical situation of that kingdom confers inestimable advantages upon it in a commercial point of view. Under careful cultivation it is capable of producing all that commerce brings together from every part of the globe : sugar, cochineal, cacao, cotton, coffee, wheat, hemp, flax, silk, oil, and wine. It furnishes every metal, not even excepting mercury, and is supplied with the finest timber ; but the coasts oppose obstacles which it will be difficult to overcome. The western shores are indeed furnished with excellent harbours ; but the eastern are almost entirely destitute of them, the mouths of the rivers there being choked up with sands, which are constantly adding to the land. Vera Cruz, the principal port on this side, is merely an open road. Both coasts, too, are rendered inaccessible for several months by severe tempests, which prevent all navigation. The north winds, *los nortes*, prevail in the Mexican Gulf from the autumnal to the vernal equinox. They are very violent in March, though usually more moderate in September and October. The navigators who have long frequented the port of Vera Cruz are familiar with the symptoms of the coming storm, which is preceded by a great change in the barometer, and a sudden interruption in the regular occurrence of its horary oscillations. At first a gentle land-wind blows from W.N.W., and is succeeded by a breeze rising from the N.E., then from the S. A suffocating heat succeeds, and the water dissolved in the atmosphere is precipitated on the walls and pavements. The summits of Orizaba, of the Cofre de Perote, and the mountains of Villa Rica, are cloudless, while their bases are concealed by vapours. In this state of the air the tempest com-

Want of
eastern
harbours.

Periodical
storms.

mences, usually with great impetuosity, and generally continues three or four days. Occasionally, even in May, June, July, and August, violent hurricanes are experienced in the Gulf of Mexico. The navigation of the western coasts is very dangerous in July and August, when sudden gales burst from the S.W.; and even in the fine season, from October to May, furious winds sometimes blow from the N.E. and N.N.E. In short, all the coasts of New Spain are at certain periods dangerous to navigators.

CHAP. XXIV.
 Dangerous navigation.

It is probable that Mexico was formerly better inhabited than it is at present; but its population was concentrated in a very small space in the neighbourhood of the capital. At the present day it is more generally distributed than it was before the conquest, and the number of Indians has increased during the last century. According to an imperfect census made in 1794, the return was estimated at 5,200,000. The proportion of births to deaths, during the time between that period and Humboldt's visit, was found, from data furnished by the clergy, to be 170 : 100; while that of births to the total amount he considers as 1 in 17, and of the deaths as 1 in 30. The annual number at present born he estimates at nearly 350,000, and that of deaths at 200,000. It would thus appear that, if this rate of increase were not checked from time to time by some extraordinary cause, the population of New Spain would double every nineteen years. In the United States generally it has doubled, since 1784, every twenty or twenty-three years; and in some of them it doubles in thirteen or fourteen. In France, on the other hand, the number of inhabitants would double in 214 years were no wars or contagious diseases to interfere. Such is the difference between countries that have long been densely peopled and those whose civilisation is of recent date. Humboldt, from various considerations, assumes the population of Mexico in 1803 at 5,800,000; and thinks it extremely probable that in 1808 it exceeded 6,500,000.

Former population.

Census.

Check on increase.

The causes which retard the increase of numbers in

CHAP. XXIV. Mexico are the small-pox ; a disease called by the Indians matlazahuatl ; and famine. The first of these, which was introduced in 1520, seems to exert its power at periods of 17 or 18 years. In 1763, and in 1779, it committed dreadful ravages, having carried off during the latter, in the capital alone, more than 9000 persons. In 1797 it was less destructive, chiefly in consequence of the zeal with which inoculation was propagated ; between 50,000 and 60,000 individuals having undergone the operation. The vaccine method was introduced in various parts of Mexico and South America at the commencement of the present century. Humboldt mentions a curious circumstance, tending to show that the discovery of our celebrated countryman, Dr Jenner, had long been known to the country people among the Andes of Peru. A negro slave, who had been inoculated for the small-pox showed no symptom of the disease, and when the practitioners were about to repeat the operation, told them he was certain that he should never take it ; for, when milking cows in the mountains, he had been affected with cutaneous eruptions, caused, as the herdsmen said, by the contact of pustules sometimes found on the udders.

Diseases.

Native remedy.

Indian distemper.

The frightful distemper called matlazahuatl, which is peculiar to the Indian race, seldom appears more than once in a century. It bears some resemblance to the yellow fever or black vomiting, which, however, very seldom attacks the natives. The extent of its ravages is not known with any degree of certainty, and it has not yet been submitted to medical investigation. Torquedama asserts that in 1545 it destroyed 800,000, and 2,000,000 in 1576 ; -but these estimates are considered by Humboldt as greatly exaggerated.

Famine.

A third obstacle to the progress of population in New Spain is famine. The American Indians, naturally indolent, contented with the smallest quantity of food on which life can be supported, and living in a fine climate, merely cultivate as much maize, potatoes, or wheat, as is necessary for their own maintenance, or at most for

the additional consumption of the adjacent towns and mines. The inhabitants of Mexico have increased in a greater ratio than the means of subsistence, and accordingly, whenever the crops fall short of the demand, or are damaged by drought or other local causes, famine ensues. With want of food comes disease; and these visitations, which are of not unfrequent occurrence, are very destructive.

CHAP XXIV.

Frequent failure of food.

The working of the mines has also contributed to the depopulation of America. At the period of the conquest many Indians perished from excessive toil, and as they were forced from their homes to distant places, they usually died without leaving progeny. In New Spain, however, such labour has been free for many years. The number employed in it does not exceed 28,000 or 30,000, and the mortality among them is not much greater than in other classes.

Effect of the mines.

The Mexican population consists of the same elements as that of the other Spanish colonies. Seven races are distinguished:—1. *Gachupines*, or persons born in Europe; 2. Spanish *Creoles*, or Whites of European extraction born in America; 3. *Mestizoes*, descendants of Whites and Indians; 4. *Mulattoes*, descendants of Whites and Negroes; 5. *Zamboes*, descendants of Negroes and Indians; 6. *Indians* of the indigenous race; and 7. African *Negroes*.

Mexican population.

The Indians appear to constitute at least two-fifths of the whole. Humboldt seems to favour the opinion, that the Aztecs, who inhabited New Spain at the period of the conquest, may have been of Asiatic origin. As the migrations of the American tribes have always taken place from north to south, the native population of this country must necessarily consist of very heterogeneous elements. The number of languages exceeds twenty; and of these fourteen have tolerably complete grammars and dictionaries. Most of these tongues, so far from being only dialects of the same, as some authors have asserted, present as little affinity to each other as the Greek and the German. The variety spoken by the

Number of Indians.

Languages.

CHAP. XXIV. indigenous inhabitants of America forms a very striking contrast with the small number used in Asia and Europe. The Aztec or Mexican is the most widely distributed.

Physical
character of
the Indians.

The Indians of New Spain bear a general resemblance to those of Florida, Canada, Peru, and Brazil. They have the same dingy copper colour, straight and smooth hair, deficient beard, squat body, elongated and oblique eyes, prominent cheek-bones, and thick lips. But although the American tribes have thus a certain uniformity of character, they differ as much from each other as the numerous varieties of the European or Caucasian race. Those who live in this province have a more swarthy complexion than the inhabitants of the warmest parts of the South. They have also a much more abundant beard than the other tribes, and in the neighbourhood of the capital they even wear small moustaches. Pursuing a quiet and indolent life, and accustomed to uniform nourishment of a vegetable nature, they would no doubt attain a very great longevity were they not extremely addicted to drunkenness.

Moral degra-
dation.

They exist in a state of great moral degradation, being entirely destitute of religion, although they have exchanged their original rites for those of Catholicism. The men are grave, melancholic, and taciturn; forming a striking contrast to the negroes, who for this reason are preferred by the Indian women. Long habituated to slavery, they patiently suffer the privations to which they are frequently subjected; opposing to them only a degree of cunning, veiled under the appearance of apathy and stupidity. Although destitute of imagination, they are remarkable for the facility with which they acquire a knowledge of languages; and, notwithstanding their usual taciturnity, they become loquacious and eloquent when excited by important occurrences. It is unnecessary to speak of the negroes, of whom there are very few in Mexico, their character being the same as in other countries where slavery is permitted.

Acquirement
of languages.

No city of the New Continent, not even excepting

those of the United States, possesses more important scientific establishments than Mexico. Of these Humboldt mentions particularly the School of Mines, the Botanic Garden, which has however fallen into a state of neglect, and the Academy of Fine Arts. The influence of this institution is perceptible in the symmetry of the buildings which adorn the capital.

New Spain is divided into 15 districts, which he arranges as follows :—

I. In the TEMPERATE ZONE—82,000 square leagues ; 677,000 inhabitants, or 8 to the square league—(978,834 square miles ; inhabitants $\frac{8}{3}$ to the square mile). CHAP. XXIV
—
Scientific establishments of Mexico.

A. Northern Region, in the interior.

1. Province of New Mexico along the Rio del Norte, to the north of the parallel of 31°.

2. Intendancy of New Biscay, to the south-west of the Rio del Norte, on the central table-land.

B. North-western Region, in the vicinity of the Pacific Ocean.

3. Province of New California, on the north-west coast of North America.

4. Province of Old California, the southern extremity of which enters the torrid zone.

5. Intendancy of La Sonora, which also passes the tropic.

C. North-eastern Region, adjoining the Gulf of Mexico.

6. Intendancy of San Luis Potosi.

II. In the TORRID ZONE—36,500 square leagues ; 5,160,000 inhabitants, or 141 to the square league—(436,700 square miles ; inhabitants 12 to the square mile). Districts of the torrid zone.

D. Central Region.

7. Intendancy of Zacatecas.

8. Intendancy of Guadalajara.

9. Intendancy of Guanajuato.

10. Intendancy of Valladolid.

11. Intendancy of Mexico.

12. Intendancy of Puebla.

13. Intendancy of Vera Cruz.

E. South-western Region.

14. Intendancy of Oaxaca.

15. Intendancy of Merida.

Without attempting to present an analysis of our author's statistical account of these different provinces,

CHAP. XXIV. we shall select from his descriptions those parts which may prove most interesting to the general reader.

Intendancy
of Mexico.

1. The intendancy of Mexico is entirely within the torrid zone. More than two-thirds of it is mountainous, and contains extensive plains elevated from 6561 to 7545 feet above the sea. Only one summit, the Nevado de Toluca, 15,156 feet in height, enters the region of perpetual snow.

Valley of
Mexico.

The valley of Mexico, or Tenochtitlan, which is of an oval form, is situated in the centre of the cordillera of Anahuac, and is 63 miles in length by 43 in breadth. It is surrounded by a ridge of mountains, more elevated on the southern side, where it is confined by the great volcanoes of La Puebla, Popocatepetl, and Iztaccihuatl. The capital stands in the immediate vicinity of one of the great lakes which exist in this beautiful valley, although formerly it was placed on an island in that sheet of water, and communicated with the shore by three great dikes. This city is represented by Humboldt as one of the finest ever built by Europeans in either hemisphere, and all travellers agree in admiring its beauty. "From an eminence," says Captain Lyon in his interesting Journal, "we came suddenly in sight of the great valley of Mexico, with its beautiful city appearing in the centre surrounded by diverging shady paséos, bright fields, and picturesque haciendas. The great lake of Tezcuco lay immediately beyond it, shaded by a low floating cloud of exhalations from its surface, which hid from our view the bases of the volcanoes of Popocatepetl and Iztaccihuatl; while their snowy summits, brightly glowing beneath the direct rays of the sun, which but partially illumined the plains, gave a delightfully novel appearance to the whole scene before me. I was, however, at this distance, disappointed as to the size of Mexico; but its lively whiteness and freedom from smoke, the magnitude of the churches, and the extreme regularity of its structure, gave it an appearance which can never be seen in a European city, and declare it unique, perhaps unequalled in its kind."

Its appear-
ance.

The ground it occupies is every where perfectly level, CHAP. XXIV.
 the streets are regular and broad, the architecture Site of the
 generally of a very pure style, and many of the build- city.
 ings are remarkably beautiful. Two kinds of hewn
 stone, a porous amygdaloid and a glassy felspar porphyry
 are used. The houses are not loaded with decorations,
 nor disfigured by wooden balconies and galleries. The
 roofs are terraced ; and the streets, which are clean and
 well lighted, have very broad pavements. The water
 of the lake is brackish, as is that of all the wells ; but
 the city is supplied by two fine aqueducts. The objects
 which generally attract the notice of travellers are,
 1. The cathedral, which has two towers ornamented with
 pilasters and statues ; 2. The treasury ; 3. The convents, Principal
 of which the most distinguished is that of St Francis ; buildings.
 4. The hospital ; 5. The acordada, a fine building, of
 which the prisons are spacious and well aired ; 6. The
 school of mines ; 7. The botanical garden ; 8. The
 university ; 9. The academy of fine arts ; 10. The
 equestrian statue of Charles IV. in the great square.

Few remains of ancient monuments are to be found Ancient
 in the town or its vicinity. Of those that exist, the monuments
 chief are the ruins of the Aztec dikes and aqueducts ;
 the sacrificial stone, adorned with a relieve representing
 the triumph of a Mexican king ; the great calendar in
 the plazó mayor ; the colossal statue of the goddess
 Teoyaomiqui in one of the galleries of the university ;
 the Aztec manuscripts or hieroglyphical pictures pre-
 served in the house of the viceroys ; and the foundations
 of the palace belonging to the sovereigns of Alcolhuacan
 at Tezcuco.

The only remarkable antiquities in the valley of Pyramida.
 Mexico are the remains of the two pyramids of San
 Juan de Teotihuacan, to the north-east of the lake of
 Tezcuco, consecrated to the sun and moon. One of
 these in its present state is a hundred and eighty feet in
 height, the other a hundred and forty-four. The
 interior is clay mixed with small stones, while the
 facings are of porous amygdaloid, and they are sur-

CHAP. XXIV rounded by a group of smaller elevation, disposed in a regular series. Another ancient object worthy of notice is the military entrenchment of Xochicalco, to the S.S.W. of the town of Cuernavaco, near Tetlama. It consists of a hill 383 feet high, surrounded by ditches or trenches, and divided into five terraces covered with masonry; the whole forming a truncated pyramid, the four faces of which correspond to the four cardinal points. The porphyritic stones are adorned with hieroglyphical figures, among which are crocodiles, and men sitting cross-legged in the Asiatic manner. Other relics and places connected with the history of the conquest are shown to the stranger; but of these it is unnecessary to speak.

Entrenchment of Xochicalco.

Our author estimates the population of Mexico as follows:—

	Inhabitants.
White Europeans,.....	2,500
White Creoles,.....	65,000
Copper-coloured natives,.....	33,000
Mestizoes, mixture of Whites and Indians,...	26,500
Mulattoes,.....	10,000
	137,000

Births and deaths.

The annual number of births for a mean term of 100 years is 5930, and that of deaths 5050; while in New Spain in general, the relation of the births to the population is as 1 to 17, and that of the deaths as 1 to 30, so that the mortality in the capital appears much greater. The great conflux of sick persons to the hospitals, and on the other hand the celibacy of the numerous clergy, the progress of luxury, and other causes, induce this disproportion.

Food.

According to researches made by the Count de Revillagigedo, the consumption of Mexico in 1791 was as follows:—

I. ANIMAL FOOD.

Wen,.....	16,300	Fowls,.....	1,255,340
Calves,.....	450	Ducks,.....	125,000
Sheep,.....	278,923	Turkeys,.....	205,000
Hogs,.....	50,676	Pigeons,.....	65,300
Kids and Rabbits,.....	24,000	Partridges,.....	140,000

II. GRAIN.

Maize, or Indian corn—cargas of 3 fanegas, 117,224=545,219 I. S. bushels. CHAP. XXIV
 Barley—cargas, 40,219=187,062 I. S. bushels. Grain.
 Wheat flour—cargas of 12 arrobas, 130,000=353,229 cwt.

III. LIQUIDS.

Pulque, the fermented juice of agave—cargas, 294,790=800,987 cwts.
 Wine and vinegar—barrels of 4½ arrobas, 4,507=71,756 I. S. galls.
 Brandy—barrels, 12,000=191,052 I. S. galls.
 Spanish oil—arrobas of 25 pounds, 5,585=15,530 I. S. galls.

The market is abundantly supplied with vegetables of numerous kinds, which are brought in every morning by the Indians in boats. Most of these are cultivated on the chinampas or gardens, some of which float upon the neighbouring sheet of water, while others are fixed in the marshy grounds.* Market.

The surface of the four principal lakes in the valley of Mexico occupies nearly a tenth of its extent, or 168 square miles. The lake of Xochimilco contains 49½, that of Tezcuco 77, of San Christobal 27½, and of Zumpango 91½, square miles. The valley is itself a basin enclosed by a wall of porphyritic mountains, and all the water furnished by the surrounding cordilleras is collected in it. No stream issues from it excepting the brook of Tequisquiac, which joins the Rio de Tula. The lakes rise by stages in proportion to their distance from its centre, or, in other words, from the site of the capital. Next to the lake of Tezcuco, Mexico is the least elevated point of the valley, the plazo mayor or great square being only 1 foot 1 inch higher than the mean level of its water, which is 11½ feet lower than that of San Christobal. Zumpango, which is the most northern, is 29-211 Lakes.

* "These are long narrow stripes of ground redeemed from the surrounding swamp, and intersected by small canals. They all appeared to abound in very fine vegetables, and lively-foliaged poplars generally shadowed their extremities. The little gardens constructed on bushes or wooden rafts no longer exist in the immediate vicinity of Mexico; but I learned that some may yet been seen at Juchimilco, a place near San Augustin de las Cuevas."—*Captain Lyon's Journal of a Residence and Tour in the Republic of Mexico*, vol. ii. p. 110.

CHAP. XXIV. feet higher than the surface of Tezcuco ; while that of Chalco, at the southern extremity, is only 3·632 feet more elevated than the great square of Mexico.

Inundations. In consequence of this peculiarity the city has for a long series of ages been exposed to inundations. The lake of Zumpango, swelled by an unusual rise of the Rio de Guautitlan, flows over into that of San Christobal, which again bursts the dike that separates it from Tezcuco. The water of this last is consequently augmented, and flows with impetuosity into the streets of Mexico. Since the arrival of the Spaniards the town has experienced five great floods, the latest of which happened in 1629. In more recent periods there have been several alarming appearances, but the city was preserved from any actual loss by the desague or canal, which was formed for the purpose.

Increasing liability.

Plan for averting the danger.

The situation of the capital is more exposed to danger, because the bed of the lake is progressively rising in consequence of the mud carried into it, and the difference between it and the level of the plain diminishing. Previous to the conquest, and for some time after, it was defended by dikes ; but this method having been found ineffectual, the viceroy in 1607 employed Enrico Martinez, a native of Germany, to effect the evacuation of the lakes. After making an exact survey of the valley he presented two plans for canals, the one to empty those of Tezcuco, Zumpango, and San Christobal, the other to drain that of Zumpango alone. The latter scheme was adopted, and, in consequence, the famous subterraneous gallery of Nochistongo was commenced on the 28th November 1607. Fifteen thousand Indians were employed, and after eleven months of continued labour the work was completed. Its length was more than 21,654 feet, its breadth 11·482, and its height 13·78. On the opposite side of the hill of Nochistongo is the Rio de Tula, which runs into the Rio de Panuco, and from the northern or further extremity of the gallery an open trench, 28,215 feet long, was cut to carry the water to the former river. Soon after the current began

to flow through this artificial channel, it gradually occasioned depositions and erosions, so that it became necessary to support the roof, which was composed of marl and clay. For this purpose wood was at first employed, and afterwards masonry ; but the arches being soon undermined, the passage at length was obstructed.

CHAP. XXIV.
Obstruction
of the canal.

Several plans were now proposed, and in 1614 the court of Madrid sent to Mexico a Dutch engineer, Adrian Boot, who advised the construction of great dikes after the Indian plan. A new viceroy, however, having recently arrived, who had never witnessed the effects of an inundation, ordered Martinez to stop up the subterraneous passage, and make the water of the upper lakes return to the bed of the Tezcuco, that he might see if the danger were really so great as it had been represented. Being convinced that it was so, he ordered the German to recommence his operations in the gallery. The engineer accordingly proceeded to clear it, and continued working until the 20th June 1629, when finding the mass of water too great to be received by this narrow outlet, he closed it in order to prevent its destruction. In the morning the city of Mexico was flooded to the depth of three feet, and, contrary to expectation, remained in that state for five years. In this interval various plans were proposed for draining the neighbouring lake, although none of them was carried into effect ; but the inundation at length subsided in consequence of a succession of earthquakes.

Adrian Boot

Martinez, who had been imprisoned from a belief that he had closed the gallery for the purpose of affording the incredulous a proof of the utility of his work, was now set at liberty, and constructed the dike of San Christobal. He was ordered to enlarge the gallery ; but the operations were conducted with very little energy, and in the end it was determined to abandon the plan, to remove the top of the vault, and to convert it into an open passage by cutting through the hill. A lawyer, named Martin de Solis, undertook the management of this enterprise ; though it required nearly two centuries

Change of
Plan.

CHAP. XXIV. to complete the work ; the canal not being opened in its whole length until 1789. As it now appears, it is stated by Humboldt to be one of the most gigantic hydraulic operations executed by man. Its length is 67,537 feet, its greatest depth 197, and its greatest breadth 361.

Completion of the canal.

Precarious sources of safety.

The safety of the capital depends, 1st, On the stone dikes which prevent the water of the lake of Zumpango from passing into that of San Christobal, and the latter from flowing into the Tezcuco ; 2d, On the dikes and sluices which prevent the lakes of Chalco and Xochimilco from overflowing ; 3d, On the great cut of Enrico-Martinez, by which the Rio de Guautitlan passes across the hills into the valley of Tula ; and, 4th, On the canals by which the Zumpango and San Christobal may be completely drained. These means, however expensive and numerous as they must appear, are insufficient to secure it against inundations proceeding from the north and north-west ; and our author asserts, that it will continue exposed to great risks until a canal shall be directly opened from the lake of Tezcuco.

Towns of the intendancy.

The intendancy of Mexico contains, besides the capital, several towns of considerable size, of which the more important are, Tezcuco, Acapulco, Toluca, and Queretaro, the latter having a population of thirty-five thousand.

Government of Puebla.

2. The government of Puebla is wholly situated in the torrid zone, and is bounded on the north-east by that of Vera Cruz, on the south by the ocean, on the east by the province of Oaxaca, and on the west by that of Mexico. It is traversed by the cordilleras of Anahuac, and contains the highest mountain in New Spain, the volcano of Popocatepetl. A great portion, however, consists of an elevated plain, on which are cultivated wheat, maize, agave, and fruit-trees.

Ancient remains.

The population is concentrated on this table-land, extending from the eastern slope of the Nevados, or Snowy Mountains, to the vicinity of Perote. It exhibits remarkable vestiges of ancient Mexican civilisation. The great pyramid of Cholula has a much larger base than any edifice of the kind in the Old Continent, its horizontal

breadth being not less than 1440 feet ; but its present height is only fifty-nine yards, while the platform on its summit has a surface of 45,210 feet. CHAP. XXIV.

At the village of Atlixco is seen a cypress (*Cupressus disticha*) 76 feet in circumference, which is probably one of the oldest vegetable monuments on the globe.* There are very considerable salt-works in this intendency, and a beautiful marble is quarried in the vicinity of Puebla. The principal towns are that just named, containing a population of 67,800, Cholula, Tlascala, and Atlixco. Gigantic cypress.

3. The intendency of Guanaxuato, situated on the ridge of the cordillera of Anahuac, is the most populous in New Spain, and contains three cities, Guanaxuato, Celayo, and Salvatierra, four towns, 37 villages, and 448 farms or haciendas. It is in general highly cultivated, and possesses the most important mines in that section of the New World. Guanaxuato

4. The intendency of Valladolid is bounded on the north by the Rio de Lerma ; on the east and north-east by that of Mexico ; on the south by the district of Guanaxuato ; and on the west by the province of Guadalupe. Being situated on the western declivity of the cordillera of Anahuac, and intersected by hills and beautiful valleys, it in general enjoys a mild and temperate climate. The volcano of Jorullo, already described, is situated in this intendency, which has three cities, three towns, and 263 villages. The southern part is inhabited by Indians. Valladolid.

5. The province of Guadalupe is bounded on the north by the governments of Sonora and Durango, on Governments of Sonora and Durango.

* " On entering the gardens of Chapultepec (near Mexico), the first object that strikes the eye is the magnificent cypress (*Sabino Ahuahuate*, or *Cupressus disticha*), called the Cypress of Montezuma. It had attained its full growth when that monarch was on the throne (1520), so that it must now be at least 400 years old, yet it still retains all the vigour of youthful vegetation. The trunk is 41 feet in circumference, yet the height is so majestic as to make even this enormous mass appear slender."—*Ward's Mexico in 1827*, vol. ii. p. 230. The same author mentions another cypress, 38 feet in girth, and of equal height to that of Montezuma.

CHAP. XXIV. the east by those of Zacatecas and Guanajuato, on the south by the district of Valladolid, and on the west by the Pacific Ocean. Its greatest breadth is 345 miles, and its greatest length 407. It is crossed from east to west by the Rio de Santiago, which is of considerable size. The eastern portion consists of the elevated platform and western declivity of the cordilleras of Anahuac. The maritime parts are covered with forests which abound in excellent timber. The volcano of Colima, situated in this district, is the most western of those of New Spain. It frequently throws up ashes and smoke; but its height is not so great as to carry its summit into the region of perpetual snow. The most remarkable towns are, Guadalajara, which has a population of 10,500, San Blas, a port at the mouth of the Santiago, and Compostella.

Rio de
Santiago.

Intendancy
of Zacatecas.

6. The intendancy of Zacatecas, bounded on the north by Durango, on the east by San Luis Potosi, on the south by Guanajuato, and on the west by Guadalajara, is 293 miles in length, and 176 in breadth. The tableland, which forms its central part, is composed of syenite and primitive slate. Near Zacatecas are nine small lakes abounding in muriate and carbonate of soda. This district is very thinly peopled, although the town has 33,000 inhabitants.

Oaxaca.

7. The intendancy of Oaxaca is one of the most delightful countries in the New Continent, possessing great fertility of soil and salubrity of climate. It is bounded on the north by the intendancy of Vera Cruz; on the east by Guatemala; on the west by the province of Puebla; and on the south by the Pacific Ocean. The mountainous parts are composed of granite and gneiss. The vegetation is every where exceedingly beautiful. At the village of Santa Maria del Tule, ten miles east of the capital, there is an enormous trunk of *Cupressus disticha*, 118 feet in circumference, though it seems rather to be formed of three stems grown into one.

Palace of
Mitla.

The most remarkable object in this district is the palace of Mitla, the walls of which are decorated with

grecques and labyrinths in mosaic, resembling the ornaments of Tuscan vases. It consists of three edifices, and is moreover distinguished from other ancient Mexican buildings by six porphyritic columns which support the ceiling of a vast hall. These pillars have neither base nor capital; each exhibits a single block of stone, and the height is about sixteen feet. Oaxaca, the principal town, contained in the year 1792 twenty-four thousand inhabitants. Some of the mines are very productive.

CHAP. XXIV.
Decorations.

8. The intendency of Merida comprehends the great peninsula of Yucatan, situated between the Bay of Campeachy and that of Honduras. It is bounded on the south by Guatemala, on the east by the province of Vera Cruz, and on the west by the English establishments, which extend from the mouth of the Rio Hondo to the north of the Bay of Hanover. This peninsula is a vast plain intersected by a chain of hills; and though one of the warmest, it is at the same time one of the healthiest provinces of equinoctial America. The latter circumstance is to be attributed to the extreme dryness of the soil and atmosphere. No European grain is produced; but maize, jatropha, and dioscorea, are cultivated in abundance. The Hæmatoxylon or Campeachy wood abounds in several districts. Merida, the capital, has a population of 10,000.

Intendency
of Merida.

9. The government of Vera Cruz extends along the Mexican Gulf from the Rio Baraderas to the great river of Panuco. The western part forms the declivity of the cordilleras of Anahuac, whence, amid the regions of perpetual snow, the inhabitants descend in a day to the burning plains of the coast. In this district are displayed in a remarkable manner the gradations of vegetation, from the level of the sea to those elevated summits which are visited with perennial frost. In ascending, the traveller sees the physiognomy of the country, the aspect of the sky, the form of the plants, the figures of animals, the manners of the inhabitants and the kind of cultivation followed by them, assuming

Government
of Vera Cruz

- CHAP. XXIV.** a different appearance at every step. Leaving the lower districts, covered with a beautiful and luxuriant vegetation, he first enters that in which the oak appears, where he has no longer cause to dread the yellow fever, so fatal on the coasts. Forests of liquidambar, near Kalapa, announce by their freshness the elevation at which the strata of clouds, suspended over the ocean, come in contact with the basaltic summits of the cordilleras. A little higher the banana ceases to yield fruit. At the height of San Miguel pines begin to mingle with the oaks, which continue as far as the plains of Perote, where the cereal vegetation of Europe is seen. Beyond this, the former alone cover the rocks, the tops of which enter the region of perpetual frigidity.
- Elevated regions.**
- Forests.** At the foot of the cordillera, in the evergreen forests of Papantla, Nautla, and S. Andre Tuxtla, grows the vanilla, the fruit of which is used for perfuming chocolate. The beautiful convolvulus, whose root furnishes the jalap of the apothecaries, grows near the Indian villages of Colipa and Misantla. The pimento-myrtle is produced in the woods which extend towards the river of Baraderas. On the declivities of Orizaba, tobacco of excellent quality is cultivated; and the sarsaparilla grows in the moist and shady ravines. Cotton and sugar of excellent quality are produced along the greater part of the coast.
- Evergreen forests.** In this intendency are two colossal summits,—the volcano of Orizaba, which after Popocatepetl is the highest in New Spain, and the Cofre de Perote, which is nearly 1312 feet more elevated than the Peak of Teneriffe. In its northern part, near the Indian village of Papantla, is a pyramidal edifice of great antiquity situated in the midst of a thick forest. It is not constructed of bricks, or clay mixed with stone and faced with amygdaloid, like those of Cholula and Teotihuacan; on the contrary, the materials employed have been immense blocks of porphyry. The base is an exact square, 82 feet on each side, and the perpendicular
- Volcano of Orizaba.**

height seems to be about sixty. It is composed of several stages, of which some are still distinguishable. A great stair of 57 steps conducts to the truncated summit

CHAP. XXIV
Cities of the
intendency.

The most remarkable cities are Vera Cruz, Perote, Cordoba, and Orizaba. The first of these, the centre of European and West Indian commerce, is beautifully and regularly built; but it is situated in an arid plain destitute of running water, and partly covered with shifting sand-hills, which contribute to increase the suffocating heat of the air. In the midst of these downs are marshy lands covered with rhizophoræ and other plants. No stones for architectural purposes are to be found near the city, which is entirely constructed of coral-rock drawn from the bottom of the sea. The water is very bad, and is obtained either by digging in the sandy soil, or by collecting the rain in cisterns.

Xalapa, the population of which is estimated at 13,000, occupies a very romantic situation at the foot of the basaltic mountain of Macultepec, surrounded by forests of styrax, piper, melastomæ, and tree-ferns. The sky is beautiful and serene in summer, but from December to February it has a most melancholy aspect, and whenever the north wind blows, is overcast to such a degree that the sun and stars are frequently invisible for two or three weeks together. Some of the merchants of Vera Cruz have country-houses at Xalapa, where they enjoy a cool and agreeable retreat; while the coast is almost uninhabitable, on account of the intense heats, the mosquitoes, and the yellow fever.

Xalapa.

10. The intendancy of San Luis Potosi embraces the whole north-eastern part of New Spain, and is extremely diversified in its character. The only portion which is cold and mountainous is that adjoining the province of Zacatecas, and in which are the rich mines of Charcas, Guadalcázar, and Catorce. There is a great extent of low ground, partly cultivated, but for the most part barren and uninhabited. Its coast line is more than 794 miles in length; but hardly any commerce enlivens it, owing to the deficiency of harbours. The mouths of

San Luis
Potosi.

CHAP. XXIV. the rivers, too, are blocked up by bars, necks of land, and long islands running parallel to the coast.

Durango.

11. New Biscay or Durango occupies a greater space of ground than Great Britain and Ireland, though its population does not exceed 160,000. It is bounded on the south by Zacatecas and Guadalupe ; on the south-east by San Luis ; and on the west by Sonora. On the northern and eastern sides, for more than 690 miles, it borders on an uncultivated country inhabited by independent Indians. This intendancy comprehends the northern extremity of the great table-land of Anahuac, which declines towards the Rio Grande del Norte.

Sonora.

12. The province of Sonora is still more thinly peopled than Durango. It extends on the shores of the Gulf of California more than 966 miles.

New Mexico.

13. New Mexico, which is very sparingly inhabited, stretches along the Rio Norte, and has a remarkably cold climate.

Old California.

14. Old California equals England in extent of territory, but has only a population of 9000. The soil of this peninsula is parched and sandy, and the vegetation feeble ; but the sky is constantly clear and of a deep blue ; the light clouds which sometimes appear presenting at sunset the most beautiful shades of violet, purple, and green. A chain of mountains, the highest of which is about 5000 feet, runs through the centre of the peninsula and is inhabited by animals resembling the mouflon of Sardinia, which the Spaniards call wild sheep. The principal attraction which California has afforded to Europeans since the 16th century is the great quantity of pearls found in it, and which, although frequently of an irregular form, are large and of a very beautiful water. At the present day, however, this fishery is almost entirely abandoned.

New California.

15. New California is a long and narrow country, identifying itself with the shore of the Pacific Ocean from the isthmus of Old California to Cape Mendocino. It is extremely picturesque, and enjoys a fertile well-watered soil, with a temperate climate. Wheat, barley,

maize, beans, and other useful plants, thrive well, as do the vine and olive ; but the population is scanty compared to the territory. A cordillera of small elevation runs along the coast, and the forest and prairies are filled with deer of gigantic size.

CHAP XXIV.

Gigantic
deer.

CHAPTER XXV.

Statistical Account of New Spain continued.

Agriculture of Mexico—Banana, Manioc, and Maize—Cereal Plants—Nutritive Roots and Vegetables—Agave Americana—Colonial Commodities—Cattle and Animal Productions.

CHAP. XXV.

Modifications
of climate.

A COUNTRY extending from the sixteenth to the thirty-seventh degree of latitude, and presenting a great variety of surface, necessarily affords numerous modifications of climate. Such is the admirable distribution of heat on the globe, that the strata of the atmosphere become colder as we ascend, while those of the sea are warmest near the surface. Hence, under the tropics, on the declivities of the cordilleras, and in the depths of the ocean, the plants and marine animals of the polar regions find a temperature suited to their development. It may easily be conceived that, in a mountainous country like Mexico, having so great a diversity of elevation, temperature, and soil, the variety of indigenous productions must be immense; and that most of the plants cultivated in other parts of the globe may there find situations adapted to their nature.

Objects of
agriculture.

There, however, the principal objects of agriculture are not the productions which European luxury draws from the West India Islands, but the grasses, nutritive roots, and the agave. The appearance of the land proclaims to the traveller that the natives are nourished by the soil, and that they are independent of foreign commerce. Yet agriculture is by no means so flourish-

ing as might be expected from its natural resources, CHAP. XXV
 although considerable improvement has been effected of Effects of
 late years. The depressed state of cultivation, it is working
 true, has been attributed to the existence of numerous mines.
 rich mines; but Humboldt, on the contrary, maintains
 that the working of these ores has been beneficial in
 causing many places to be improved which would
 otherwise have remained sterile. When a vein is opened
 on the barren ridge of the cordilleras, the new colonists
 can only draw the means of subsistence from a great
 distance. Want soon excites to industry, and farms Stimulus to
 begin to be established in the neighbourhood. The high industry.
 price of provisions indemnifies the cultivator for the
 hard life to which he is exposed, and the ravines and
 valleys become gradually covered with food. When
 the mineral treasures are exhausted, the workmen no
 doubt emigrate, so that the population is diminished;
 but the settlers are retained by their attachment to the
 spot in which they have passed their childhood. The
 Indians, moreover, prefer living in the solitudes of the
 mountains remote from the whites, and this circumstance
 tends to increase the number of inhabitants in such
 districts.

In describing the vegetable productions of New Spain, Vegetable
 our author begins with those which form the principal production.
 support of the people, then treats of the class which
 affords materials for manufacture, and ends with such
 as constitute objects of commerce.

The banana (*Musa paradisiaca*) is to the inhabitants Banana.
 of the torrid zone what the cereal grasses,—wheat,
 barley, and rye,—are to Western Asia and Europe, and
 what the numerous varieties of rice are to the natives of
 India and China. Forster and other naturalists have
 maintained, that it did not exist in America previous to
 the arrival of the Spaniards, but that it was imported
 from the Canary Islands in the beginning of the 16th
 century; and in support of this opinion may be adduced
 the silence of Columbus, Alonzo Negro, Pinzon, Ves-
 pucci, and Cortes, with respect to it. This circumstance,

- CHAP. XXV.** however, only proves the inattention of these travellers to the productions of the soil; and it is probable that the *Musa* presented several species indigenous to different parts of both continents. The space favourable to the cultivation of this valuable plant in Mexico is more than 50,000 square leagues, and has nearly a million and a half of inhabitants. In the warm and humid valleys of Vera Cruz, at the foot of the cordillera of Orizaba, the fruit occasionally exceeds 11·8 inches in circumference, with a length of seven or eight. A bunch sometimes contains from 160 to 180, and weighs from 66 to 88 lb. avoirdupois.
- Extent of cultivation.** Humboldt doubts whether there is any other plant on the globe which, in so small a space of ground, can produce so great a mass of nutriment. Eight or nine months after the sucker has been inserted in the earth the banana begins to form its clusters, and the fruit may be gathered in less than a year. When the stalk is cut, there is always found among the numerous shoots which have put forth roots one that bears three months later. A plantation is perpetuated without any other care than that of cutting the stems on which the fruit has ripened, and giving the earth a slight dressing. A spot of 1076 square feet may contain at least from thirty to forty plants, which, in the space of a year, at a very moderate calculation, will yield more than 4410 lb. avoirdupois of nutritive substance. Our author estimates, that the produce of the banana is to that of wheat, as 133 : 1, and to that of potatoes as 44 : 1.
- Great nutriment.** In America numerous preparations are made of this fruit, both before and after its maturity. When fully ripe it is exposed to the sun, and preserved like our figs; the skin becoming black, and exhaling a peculiar odour like that of smoked ham. This dry banana (*platano pasado*), which is an object of commerce in the province of Mechoacan, has an agreeable taste, and is a very wholesome article of food. Meal or flour is obtained from it, by being cut into slices, dried in the sun, and pounded.
- Ease of cultivation.**
- Modes of preparation.**

It is calculated that the same extent of ground in Mexico on which the banana is raised is capable of maintaining fifty individuals, whereas in Europe, under wheat it would not furnish subsistence for two; and nothing strikes a traveller more than the diminutive appearance of the spots under culture round a hut which contains a numerous family. CHAP. XXV.
Economy of
space.

The region where it is cultivated produces also the valuable plant *Jatropha*, of which the root, as is well known, affords the flour of manioc, usually converted into bread, and furnishes what the Spanish colonists call *pan de tierra caliente*. This vegetable is only successfully grown within the tropics, and in the mountainous region of Mexico is never seen above the elevation of 2625 feet. Two kinds are raised, the sweet and the bitter. The root of the former may be eaten without danger, while that of the latter is a very active poison. Both may be made into bread; but the bitter is preferred for this purpose, the poisonous juice being carefully separated from the fecula, called cassava, before making the dough. Jatropha.
Bread. Raynal asserted that the manioc was transported from Africa to America to serve for the maintenance of the negroes; but our author shows that it was cultivated there long before the arrival of Europeans on that side of the Atlantic. The bread made of it is very nutritive; but, being extremely brittle, it does not answer for distant carriage. The fecula, however, grated, dried, and smoked, is used on journeys. The root loses its poisonous qualities on being boiled, and in this state the decoction is used as a sauce, although serious accidents sometimes happen when it has not been long enough exposed to heat. The husbandry of it, we may observe, requires more care than that of the banana. In this respect it resembles the potato; and the roots are ripe in seven or eight months after the slips have been planted.

The same region produces maize, the cultivation of which is more extensive than that of the banana and manioc. Maize. Advancing towards the central plains, we meet

CHAP. XXV. Grain. with fields of this important plant all the way from the coast to the valley of Toluca, which is upwards of 9186 feet above the sea. Although a great quantity of other grain is produced in Mexico, this must be considered as the principal food of the people, as well as of most of the domestic animals, and the year in which the maize-harvest fails is one of famine and misery to the inhabitants. There is no longer a doubt among botanists that this plant is of American origin, and that the Old Continent received it from the New.

Rye and Barley.

It does not thrive in Europe where the mean temperature is less than 44° or 46°; and on the cordilleras of New Spain rye and barley are seen to vegetate vigorously where the cultivation of maize would not be attended with success. On the other hand, the latter thrives in the lowest plains of the torrid zone, where wheat, barley, and rye, are not found. Hence we cannot be surprised to hear that it occupies a much greater extent in equinoctial America than the grains of the Old Continent.

Fertility.

The fecundity of the Mexican variety is astonishing. Fertile lands usually afford a return of 300 or 400 fold, and in the neighbourhood of Valladolid a harvest is considered defective when it yields only 130 or 150. Even where the soil is most steril the produce varies from sixty to eighty. The general estimate for the equinoctial region of Mexico may be considered as a hundred and fifty.

Great variations.

Of all the gramina cultivated by man, none is so unequal as this in its produce, as it varies in the same field according to the season from forty to 200 or 300 for one. If the harvests are good, the agriculturist makes his fortune more rapidly than with any other grain; but frightful dearths sometimes occur, when the natives are obliged to feed on unripe fruit, cactus-berries, and roots. Diseases arise in consequence; and these famines are usually attended with a great mortality among the children. Fowls, turkeys, and even cattle suffer, so that the traveller can find neither eggs nor poultry. Scar-

cities of less severity are not uncommon, and are especially felt in the mining districts, where the vast numbers of mules employed in the process of amalgamation annually consume an enormous quantity of maize. CHAP. XXV. Frequent scarcity.

Numerous varieties of food are derived from this plant. The ear is eaten raw or boiled. The grain when beaten affords a nutritive bread called arepa, and the meal is employed in making soups or gruels, which are mixed with sugar, honey, and sometimes even pounded potatoes. Many kinds of drink are also prepared from it, some resembling beer, others cider. In the valley of Tolucca the stalks are squeezed between cylinders, and from the fermented juice a spiritous liquor, called *pulque de mahis*, is procured. Varieties of food.

In favourable years Mexico yields a much larger quantity than is necessary for its own consumption; but as this grain affords less nutritive substance in proportion to its bulk than the corn of Europe, and as the roads are generally difficult, obstacles are presented to its transportation, which, however, will diminish when the country is more improved. Excess of production.

We come now to the cereal plants which have been conveyed from the Old to the New Continent. A negro slave of Cortes found among the rice, which served to maintain the Spanish army, three or four particles of wheat, which were sown, we may suppose, before the year 1530. A Spanish lady, Maria d'Escobar, carried a few grains to Lima, and their produce was distributed for three years among the new colonists, each receiving twenty or thirty seeds. At Quito the first European corn was sown near the convent of St Francis by Father Jose Rixi, a native of Flanders; and the monks still show, as a precious relic, the earthen vessel in which the original wheat came from Europe. "Why," asks our author, "have not men preserved every where the names of those who, in place of ravaging the earth, have enriched it with plants useful to the human race?" Cereal plants. Wheat.

The temperate region appears most favourable to the cultivation of the cerealia, or nutritive grasses known to

CHAP. XXV. the ancients, namely, wheat, spelt, barley, oats, and rye. In the equinoctial part of Mexico they are nowhere grown in plains of which the elevation is under 2625 feet; and on the declivity of the cordilleras between Vera Cruz and Acapulco they commence at the height of 3937. At Xalapa wheat is raised solely for the straw; for there it never produces seed, although in Guatemala grain ripens at smaller elevations.

Scarcity of moisture. Were the soil of New Spain watered by more frequent showers, it would be one of the most fertile portions of the globe. In the equinoctial districts of that country there are only two seasons,—the wet, from June or July to September or October, and the dry, which lasts eight months. The rains, accompanied with electrical explosions, commence on the eastern coast, and proceed westward, so that they begin fifteen or twenty days sooner at Vera Cruz than on the central plains. Sometimes they are seen, mixed with sleet and snow, in the elevated parts during November, December, and January, but they last only a few days. It is seldom that the inhabitants have to complain of humidity, and the excessive drought which prevails from June to September compels them in many parts to have recourse to artificial irrigation. In places not watered in this manner, the soil yields pasturage only till March or April, after which the south wind destroys the grass. This change is more felt when the preceding year has been unusually dry, and the wheat suffers greatly in May. The rains of June, however, revive the vegetation, and the fields immediately resume their verdure.

Excessive droughts. Great productiveness. In lands carefully cultivated the produce is surprising, especially in those which are watered. In the most fertile part of the table-land between Queretaro and Leon, the wheat-harvest is 35 and 40 for 1; and several farms can even reckon on 50 or 60 for 1. At Cholulo the common return is from 30 to 40, but it frequently exceeds from 70 to 80 for 1. In the valley of Mexico maize yields 200, and wheat 18 or 20. The mean produce of the whole country may be stated at 20

or 25 for 1. M. Abad, a canon of the metropolitan church of Valladolid de Mechoacan, took at random from a field of wheat forty plants, when he found that each seed had produced forty, sixty, and even seventy stalks. The number of grains which the ears contained frequently exceeded 100 or 120, and the average amount appeared to be 90. Some even exhibited 160. A few of the elevated tracts, however, are covered with a kind of clay impenetrable by the roots of herbaceous plants, and others are arid and naked, in which the cactus and other prickly shrubs alone vegetate.

The following table exhibits the mean produce of the cereal plants in different countries of both continents :—

In France, from 5 to 6 grains for 1.	Comparative table.
In Hungary, Croatia, and Sclavonia, from 8 to 10 grains.	
In La Plata, 12 grains.	
In the northern part of Mexico, 17 grains.	
In equinoctial Mexico, 24 grains.	
In the province of Pasto in Santa Fe, 25 grains.	
In the plain of Caxamarca in Peru, 18 to 20 grains.	

The Mexican wheat is of the very best quality, and equals the finest Andalusian. At Havannah it enters into competition with that of the United States, which is considered inferior to it ; and when greater facilities are afforded for exportation it will become of the highest importance to Europe. In Mexico grain can hardly be preserved longer than two or three years ; but the causes of this decay have not been sufficiently investigated.

Rye and barley, which resist cold better than wheat, are cultivated on the highest regions, but only to a small extent. Oats do not answer well in New Spain, and are very seldom seen even in the mother-country, where the horses are fed on barley.

The potato appears to have been introduced into Mexico nearly at the same period as the cereal grasses of the Old Continent. It is certain that it was not known there before the arrival of the Spaniards, at which epoch it was in use in Chili, Peru, Quito, and New Grenada. It is supposed by botanists that it grows spontaneously in the mountainous regions ; but our author asserts that

CHAP. XXV. this opinion is erroneous, and that the plant in question is nowhere to be found uncultivated in any part of the cordilleras within the tropics. According to Molina it is a native of all the fields of Chili, where another species, the *Solanum cari*, still unknown in Europe, and even in Quito and Mexico, is grown; and M. Humboldt seems to consider that country as the original source of it. It is stated that Sir Walter Raleigh found it in Virginia in 1584; and a question arises, whether it arrived there from the north, or from Chili, or some other of the Spanish colonies. Our traveller seems to consider it not improbable that it had been conveyed from some of the Spanish colonies by the English themselves.

Products of
the higher
regions.

The plants cultivated in the highest and coldest parts of the Andes and Mexican cordilleras are potatoes, the *Tropæolum esculentum*, and the *Chenopodium quinoa*. The first of these are an important object in the latter country, as they do not require much humidity. The Mexicans and Peruvians preserve them for a series of years, by destroying their power of germinating by exposure to frost, and afterwards drying them,—a practice which our author thinks might be followed with advantage in Europe. He also recommends obtaining the seeds of the potatoes cultivated at Quito and Santa Fe, which are a foot in diameter, and superior in quality to those in the Old Continent. It is unnecessary to expatiate on the advantages derived from this invaluable root, the use of which now extends from the extremity of Africa to Lapland, and from the southern regions of America to Labrador.

Nutritive
roots.

The New World is very rich in plants with nutritive roots. Next to the manioc and the potato, the most important are the *oca*, the *batate*, and the *igname*. The first of these (*Oxalis tuberosa*) grows in the cold and temperate parts of the cordilleras. The *igname* (*Dioscorea alata*) appears proper to all the equinoctial regions of the globe. Of the *batate* (*Convolvulus batatas*), several varieties are raised. The *cacomite*, a species of *Tigridia*, the root of which yields a nutritive farina; numerous

varieties of love-apples (*Solanum lycopersicum*); the earth pistachio or mani (*Arachis hypogæa*); and different species of pimento (*Capsicum*), are the other useful plants cultivated there. CHAP. XXV.

The Mexicans now have all the culinary vegetables and fruit-trees of Europe; but it has become difficult to determine which of the former they possessed before the arrival of the Spaniards. It is certain, however, that they had onions, haricots, gourds, and several varieties of Cicer; and in general, if we consider the garden-stuffs of the Aztecs, and the great number of farinaceous roots cultivated in Mexico and Peru, we shall see that they were not so poor in alimentary plants as some maintain. Culinary
vegetables.

The central table-land of New Spain produces the ordinary fruits of Europe in the greatest abundance; and the traveller is surprised to see the tables of the wealthy inhabitants loaded with the vegetable productions of both continents in the most perfect state. Before the invasion of the Spaniards, Mexico and the Andes presented several fruits having a great resemblance to those of Europe. The mountainous part of South America has a cherry, a nut, an apple, a mulberry, a strawberry, a rasp, and a gooseberry, which are peculiar to it. Oranges and citrons, which are now cultivated there, appear to have been introduced, although a small wild orange occurs in Cuba and on the coast of Terra Firma. The olive-tree answers perfectly in New Spain, but exists only in very small numbers. European
fruits.

Most civilized nations procure their drinks from the plants which constitute their principal nourishment, and of which the roots or seeds contain saccharine and amyloseous matter. There are few tribes, indeed, which cultivate these solely for the purpose of preparing beverages from them; but in the New Continent we find a people, who not only extracted liquors from the maize, the manioc, and bananas, but who raise a shrub of the family of the ananas for the express purpose of converting its juice into a spiritous liquor. This plant, the maguëy Common
liquors.

CHAP. XXV. (*Agave Americana*), is extensively reared as far as the Aztec language extends. The finest plantations of it seen by our traveller were in the valley of Toluca and on the plains of Cholula. It yields the saccharine juice at the period of inflorescence only, the approach of which is anxiously observed. Near the latter place, and between Toluca and Cacanumacan, a maguey eight years old gives signs of developing its flowers. The bundle of central leaves is now cut, the wound is gradually enlarged and covered with the foliage, which is drawn close and tied at the top. In this wound the vessels seem to deposit the juice that would naturally have gone to expand the blossoms. It continues to run two or three months, and the Indians draw from it three or four times a-day. A very vigorous plant occasionally yields the quantity of 454 cubic inches a-day for four or five months. This is so much the more astonishing, that the plantations are usually in the most arid and sterile ground. In a good soil the agave is ready for being cut at the age of five years; but in poor land the harvest cannot be expected in less than eighteen.

Mode of
collecting
the juice.

Fermenta-
tion.

This juice or *honey* has an agreeable acid taste, and easily ferments on account of the sugar and mucilage which abound in it. This process, which is accelerated by adding a little old pulque, ends in three or four days; and the result is a liquor resembling cider, but with a very unpleasant smell like that of putrid meat. Europeans who can reconcile themselves to the scent prefer the *pulque* to every other liquor, and it is considered as stomachic, invigorating, and nutritive. A very intoxicating brandy, called *mexical*, is also obtained from it, and in some districts is manufactured to a great extent.

Agave hemp.

The leaves of the agave also supply the place of hemp and the papyrus of the Egyptians. The paper on which the ancient Mexicans painted their hieroglyphical figures was made of their fibres macerated and disposed in layers. The prickles which terminate them formerly served as pins and nails to the Indians, and the priests pierced their arms and breasts with them in their acts of expiation.

The vine is cultivated in Mexico, but in so small a quantity that wine can hardly be considered as a product of that country; but the mountainous parts of New Spain, Guatemala, New Grenada, and Caraccas, are so well adapted for its growth, that at some future period they will probably supply the whole of North America.

Of colonial commodities, or productions which furnish raw materials for the commerce and manufacturing industry of Europe, New Spain affords most of those procured from the West Indies. The cultivation of the sugar-cane has of late years been carried to such an extent, that the exportation of sugar from Vera Cruz amounts to more than half a million of arrobas, or 12,680,000 lb. avoird.; which, at three piasters the arroba, are equal to 8,000,000 francs, or £318,750 sterling. It was conveyed by the Spaniards from the Canary Islands into St Domingo, from whence it was subsequently carried into Cuba and the province just named. Although the mean temperature best suited to it is 75° or 77°, it may yet be successfully reared in places of which the annual warmth does not exceed 66° or 68°; and as on great table-lands the heat is increased by the reverberation of the earth, it is cultivated in Mexico to the height of 4921 feet, and in favourable exposures thrives even at an elevation of 6562. The greatest part of the sugar produced in New Spain is consumed in the country, and the exportation is very insignificant compared with that of Cuba, Jamaica, or St Domingo.

Cotton, flax, and hemp, are not extensively raised, and very little coffee is used in the country. Cocoa, vanilla, jalap, and tobacco, are cultivated; but of the latter there is a considerable importation from Havannah. Indigo is not produced in sufficient quantity for home consumption.

Since the middle of the sixteenth century, oxen, horses, sheep, and hogs, introduced by the conquerors, have multiplied surprisingly in all parts of New Spain, and more especially in the vast savannahs of the provin-

CHAP. XXV.

Vine.

Sugar cane.

Cotton and coffee.

Domestic animals.

CHAP. XXV. *cias internas.* The exportation of hides is considerable, as is that of horses and mules.

Poultry. Our common poultry have only of late years begun to thrive in Mexico; but there is a great variety of native gallinaceous birds in that country, such as the turkey, the hocco or curassow (*Cras nigra*, *C. globicera*, *C. pauxi*), penelopes, and pheasants. The Guinea fowl and common duck are also reared; but the goose is nowhere to be seen in the Spanish colonies.

Silkworms. The cultivation of the silkworm has never been extensively tried, although many parts of that continent seem favourable to it. An enormous quantity of wax is consumed in the festivals of the church; and notwithstanding that a large proportion is collected in the country, much is imported from Havannah. Cochineal is obtained to a considerable amount.

Pearls. Although pearls were formerly found in great abundance in various parts of America, the fisheries have now almost entirely ceased. The western coast of Mexico abounds in cachalots or spermaceti-whales (*Physeter macrocephalus*); but the natives have hitherto left the pursuit of these animals to Europeans.

CHAPTER XXVI.

Mines of New Spain.

Mining Districts—Metalliferous Veins and Beds—Geological Relations of the Ores—Produce of the Mines—Recapitulation.

THE mines of Mexico have of late years engaged the attention and excited the enterprise of the English in a more than ordinary degree. The subject is therefore one of much interest ; but as later information may be obtained in several works, and especially in Ward's "Mexico in 1827," it is unnecessary to follow our author in all his details.

Long before the voyage of Columbus, the natives of Mexico were acquainted with the uses of several metals, and had made considerable proficiency in the various operations necessary for obtaining them in a pure state. Cortes, in the historical account of his expedition, states that gold, silver, copper, lead, and tin, were publicly sold in the great market of Tenochtitlan. In all the large towns of Anahuac gold and silver vessels were manufactured, and the foreigners, on their first advance to Tenochtitlan, could not refrain from admiring the ingenuity of the Mexican goldsmiths. The Aztec tribes extracted lead and tin from the veins of Tlachco, and obtained cinnabar from the mines of Chilapan. From copper, found in the mountains of Zacotollan and Coahuixco, they manufactured their arms, axes, chisels, and other implements. With the use of iron they seem to have been unacquainted ; but they contrived to give

CHAP. XXVI.
Mines of Mexico.

Native knowledge of the metals.

Lead and tin.

CHAP. XXVI. the requisite hardness to their tools by mixing a portion of tin with the copper of which they were composed.

Number of
mines.

At the period when Humboldt visited New Spain, it contained nearly 500 places celebrated for the metallic treasures in their vicinity, and comprehending nearly 3000 mines. These were divided into 37 districts, under the direction of an equal number of councils (*Diputaciones de mineria*), as follows :—

I. INTENDANCY OF GUANAXUATO.

1. Mining District of Guanaxuato.

II. INTENDANCY OF ZACATECAS.

2. Zacatecas.		4. Fresnillo,
3. Sombrerete.		5. Sierra de Pinos.

III. INTENDANCY OF SAN LUIS POTOSI.

6. Catorce.		9. Ojocaliente.
7. Potosi.		10. San Nicolas de Croix.
8. Charcas.		

IV. INTENDANCY OF MEXICO.

11. Pachuca.		15. Zacualpan.
12. El Doctor.		16. Sultepec.
13. Zimapan.		17. Temascaltepec.
14. Tasco.		

V. INTENDANCY OF GUADALAXARA.

18. Bolanos.		20. Hostotipaquillo.
19. Asientos de Ibarra.		

VI. INTENDANCY OF DURANGO.

21. Chihuahua.		24. Cosiguiriachi.
22. Parral.		25. Batopilas.
23. Guarisamey.		

VII. INTENDANCY OF SONORA.

26. Alamos.		30. Guadalupe de la Puerta.
27. Copala.		31. Santissima Trinidad de Pe- na Blanca.
28. Cosala.		32. San Francisco Xavier de Huerta. Alisos.
29. San Francisco Xavier de la Huerta.		

VIII. INTENDANCY OF VALLADOLID.

33. Angangueo.		35. Zitaquaro.
34. Inguaran.		36. Tlalpujahu.

IX. INTENDANCY OF OAXACA.

37. Oaxaca.

X. INTENDANCY OF PUEBLA.

Several Mines.

XI. INTENDANCY OF VERA CRUZ.

Three Mines.

XII. OLD CALIFORNIA.

One Mine.

In the present state of the country the veins are the most productive, and the minerals disposed in beds or masses are very rare. The former are chiefly in primitive or transition rocks, rarely in secondary deposits. In the Old Continent granite, gneiss, and mica-slate, form the central ridges of the mountain-chains; but in the cordilleras of America these rocks seldom appear externally, being covered by masses of porphyry, greenstone, amygdaloid, basalt, and other trap-formations. The coast of Acapulco is composed of granite; and as we ascend towards the table-land of Mexico, we see it pierce the porphyry for the last time between Zumpango and Sopilote. Farther to the east, in the province of Oaxaca, granite and gneiss are visible in the high plains which are of great extent, traversed by veins of gold.

Tin has not yet been observed in the granites of Mexico. In the mines of Comanja syenite contains a seam of silver; while the vein of Guanaxuato, the richest in America, crosses a primitive clay-slate passing into talc-slate. The porphyries of Mexico are for the most part eminently rich in gold and silver. They are all characterized by the presence of hornblende and the absence of quartz. Common felspar is of rare occurrence, but the glassy variety is frequently observed in them. The rich gold-mine of Villalpando, near Guanaxuato, traverses a porphyry, of which the basis is allied to clinkstone, and in which hornblende is extremely rare. The veins of Zimapan intersect porphyries, having a greenstone basis, and contain a great variety of interesting minerals, such as fibrous zeolite, stilbite, grammatite, pycnite, native sulphur, fluor,

Productive
veins.Gold, silver
and tin.

CHAP. XXVI barytes, corky asbestos, green garnets, carbonate and chromate of lead, orpiment, chrysoptase, and fire-opal.

—
Silver ores. Among the transition rocks containing ores of silver, may be mentioned the limestone of the Real del Cardonal, Xacala, and Lomo del Toro, to the north of Zimapan. In Mexico graywacke is also rich in metals.

The silver-mines of the Real de Catorce, as well as those of El Doctor and Xaschi, near Zimapan, traverse Alpine limestone, which rests on a conglomerate with siliceous cement. In that and the Jura limestone are contained the celebrated silver-mines of Tasco and Tehuilotepic, in the intendancy of Mexico; and in these calcareous rocks the metalliferous veins display the greatest wealth.

Variety of veins.

It thus appears that the cordilleras of Mexico contain veins in a great variety of rocks, and that the deposits which furnish almost all the silver exported from Vera Cruz are primitive slate, graywacke, and Alpine limestone. The mines of Potosi in Buenos Ayres are contained in primitive clay-slate, and the richest of those of Peru in Alpine limestone. Our author here observes, that there is scarcely a variety of rock which has not in some country been found to contain metals, and that the richness of the veins is for the most part totally independent of the nature of the beds which they intersect.

Advantageous situation of mines.

Great advantage is derived in working the Mexican mines, from the circumstance that the most important of them are situated in temperate regions where the climate is favourable to agriculture. Guanaxuato is placed in a ravine, the bottom of which is somewhat lower than the level of the lakes of the valley of Mexico. Zacatecas and the Real de Catorce are a little higher; but the mildness of the air at these towns, which are surrounded by the richest mines in the world, is a contrast to the cold and disagreeable atmosphere of the Peruvian districts.

Inequality.

The produce of the Mexican mines is very unequally proportioned. The 2,500,000 marks, or 1,541,015 troy

pounds of silver, annually exported to Europe and Asia from Vera Cruz and Acapulco, are drawn from a very small number. Guanaxuato, Zacatecas, and Catorce, supply more than the half; and the vein of Guanaxuato alone yields more than a fourth part of the whole silver of Mexico, and a sixth of the produce of all America. The following is the order in which the richest mines of New Spain are placed, with reference to the quantity obtained from them :—

Guanaxuato, in the intendency of the same name.
 Catorce, in the intendency of San Luis Potosi.
 Zacatecas, in the intendency of the same name.
 Real del Monte, in the intendency of Mexico.
 Bolanos, in the intendency of Guadalupe.
 Guarisamey, in the intendency of Durango.
 Sombrerete, in the intendency of Zacatecas.
 Tasco, in the intendency of Mexico.
 Batopilas, in the intendency of Durango.
 Zimapan, in the intendency of Mexico.
 Fresnillo, in the intendency of Zacatecas.
 Ramos, in the intendency of San Luis Potosi.
 Parral, in the intendency of Durango.

The veins of Tasco, Sultepec, Tlapujahua, and Pachuca, were first wrought by the Spaniards. Those of Zacatecas were next commenced, and that of San Barnabe was begun in 1548. The principal one in Guanaxuato was discovered in 1558. As the total produce of all in Mexico, until the beginning of the eighteenth century, never exceeded 369,844 troy pounds of gold and silver yearly, it must be concluded, that during the sixteenth little energy was employed in drawing forth their stores.

The silver extracted in the thirty-seven districts was deposited in the provincial treasuries established in the chief places of the intendancies; and from the reports of these offices the quantity furnished by the different parts of the country may be determined. The following is an account of the receipts of eleven of these boards from the year 1785 to 1789 :—

CHAP. XXVI.
 Annual
 exportation.

Earliest
 mines.

silver.

CHAP. XXVI.

Receipts of
silver for
four years.

	Marks of Silver.
Guanaxuato,.....	2,469,000
San Luis Potosi,.....	1,515,000
Zacatecas,.....	1,205,000
Mexico,.....	1,055,000
Durango,.....	922,000
Rosario,.....	668,000
Guadalajara,.....	509,000
Pachuca,.....	456,000
Bolano,.....	364,000
Sombrete,.....	320,000
Zimapan,.....	248,000

Sum for five years, 9,730,000 = 5,997,633 troy pounds.

Mean pro-
duce.

The mean produce of the mines of New Spain, including the northern part of New Biscay and those of Oaxaca, is estimated at above 1,541,015 troy pounds of silver,—a quantity equal to two thirds of what is annually extracted from the whole globe, and ten times as much as is furnished by all the mines of Europe.

Produce of
gold.

On the other hand the produce of the Mexican mines in gold is not much greater than those of Hungary and Transylvania; amounting in ordinary years only to 4315 troy pounds. In the former it is chiefly extracted from river-deposites by washing. Auriferous alluvia are common in the province of Sonora, and a great deal of gold has been collected among the sands with which the bottom of the valley of the Rio Hiaqui, to the east of the missions of Tarahumara, is covered. Farther to the north, in Pimeria Alta, masses of native gold weighing five or six pounds have been found. Part of it is also extracted from veins intersecting the primitive mountains. Veins of this metal are most frequent in the province of Oaxaca, in gneiss and mica-slate. The last rock is particularly rich in the mines of Rio San Antonio. Gold is also found pure, or mixed with silver-ore, in most of those which have been wrought in Mexico.

The silver supplied by the Mexican veins is extracted from a great variety of minerals. Most of it is obtained from a sulphuretted silver, arsenical gray-copper, muriate

of silver, prismatic black silver-ore, and red silver-ore. CHAP. XXVI.

Pure or native silver is of comparatively rare occurrence. ^{Other} ~~metals.~~

Copper, tin, iron, lead, and mercury, are also procured in New Spain, but in very small quantities, although it would appear that they might be found to a great extent. The mercury occurs in various deposites, in beds, in secondary formations, and in veins traversing porphyries; but the amount obtained has never been sufficient for the process of amalgamation.

The total value of gold and silver extracted from the mines of America, between 1499 and 1803, is estimated by Humboldt at 5,706,700,000 piasters, or (valuing the piaster at 4s. 4½d.) £1,248,340,625 sterling. ^{Value of the gold and silver.}

The annual produce of the mines of the New World, at the beginning of the present century, is estimated as follows:—

	Gold Marks.	Silver Marks.	Value in Dollars.
New Spain,.....	7,000	2,338,220	23,000,000
Peru,.....	3,400	611,090	6,240,000
Chili,.....	12,212	29,700	2,060,000
Buenos Ayres,.....	2,200	481,830	4,850,000
New Grenada,.....	20,505	. . .	2,990,000
Brazil,.....	29,900	. . .	4,360,000
	<u>75,217</u>	<u>3,460,840</u>	<u>43,500,000</u>

Valuing the dollar at 4s. 3d., the total annual produce would be £9,243,260.*

* According to Mr Ward (Mexico in 1827, vol. ii. p. 38), the annual average produce of the Mexican mines, before the revolution in 1810, amounted to 24,000,000 dollars, or £5,100,000, and the average exports to 22,000,000, or £4,675,000; but since the revolution the produce has been reduced to 11,000,000 dollars, or £2,337,500, while the exports in specie have averaged 13,587,052 dollars, or £2,887,253 each year. This reduction, it is unnecessary to say, has been caused by the unsettled state of the country, the emigration of the Old Spaniards, and the withdrawing of the funds which kept the mines in operation. In 1812, according to the same authority, the coinage had fallen to four and a half millions of dollars. It rose successively to six, nine, eleven, and twelve millions, which was the amount in 1819 in the capital alone. In 1820 the revolution in Spain caused a considerable fluctuation, and the coin age fell to 10,406,154 dollars. In 1821, when the separation from

CHAP. XXVI. To conclude our brief account of Humboldt's Political Essay on New Spain, it may be useful to present a few of the more interesting facts in the form of a recapitulation.

- Aspect of the country. *Physical Aspect.*—Along the centre of the country runs a chain of mountains, having a direction from south-east to north-west, and afterwards from south to north. On the ridge or summit of this chain are extended vast table-lands or platforms, which gradually decline towards the temperate zone, their absolute height within the tropics being from 7545 to 7873 feet. The declivities of the cordilleras are wooded, while the central table-land is usually bare. In the equinoctial region the different climates rise as it were one above another from the shore, where the mean temperature is about 78°, to the central plains, where it is about 62°.
- Population. *Population.*—The whole population is estimated at 5,840,000, of which 4,500,000 are Indians, 1,000,000 Creoles, and 70,000 European Spaniards.
- Agriculture. *Agriculture.*—The banana, manioc, maize, wheat, and potatoes, constitute the principal food of the people. The maguey or agave may be considered as the Indian vine. Sugar, cotton, vanilla, cocoa, indigo, tobacco, wax, and cochineal, are plentifully produced. Cattle are abundant on the great savannahs in the interior.
- Mines. *Mines.*—The annual produce in gold is 4289 lb. troy : in silver, 1,439,832 lb. ; in all, 23,000,000 of piasters (£5,031,250), or nearly half the quantity annually extracted from the mines of America. The mint of Mexico furnished from 1690 to 1803 more than 1,353,000,000 piasters (£295,968,750), and from the discovery of New Spain to the commencement of the nineteenth century, probably 2,028,000,000 piasters

the mother-country became inevitable, the coinage sunk to five millions; from which it fell to three and a half, and continued in that state during 1823 and 1824. In 1825 the foreign capitals invested began to produce some effect; but in 1826, the total amount of coinage in the five mints of the Mexican republic did not exceed 7,463,300 dollars, or £1,686,950.

(£443,625,000). Three mining districts, Guanaxuato, Zacatecas, and Catorce, yield nearly half of all the gold and silver of New Spain. CHAP. XXVI

Manufactures.—The value of the produce of the manufacturing industry of New Spain is estimated at 7,000,000 or 8,000,000 of piasters (valuing the piaster of exchange at 3s. 3½d., £1,152,083 to £1,316,667). Cotton and woollen cloths, cigars, soda, soap, gunpowder, and leather, are the principal articles manufactured. Manufac-
tures.

It is scarcely necessary to add, that the regions of America, which at the time of Humboldt's visit were Spanish colonies, have, after a series of sanguinary struggles, excited by the real or imagined grievances under which the inhabitants laboured, now succeeded in acquiring independence. This condition is more suitable than subjection to a remote power, protracted beyond the period at which such settlements are themselves fit to become empires. With colonies it is in some degree as with children. They receive the protection necessary for their growth, and obey at first from weakness and attachment; but beyond the stage at which they acquire a right to think for themselves, the attempt to perpetuate subordination necessarily excites a hatred which effectually quenches the feeble gratitude that man, in any condition, is capable of cherishing. The political divisions of America—the land of republican principles—are foreign to our object, and would require a more particular description than they could receive in this volume. Political in-
dependencia.

CHAPTER XXVII.

*Passage from Vera Cruz to Cuba and Philadelphia,
and Voyage to Europe.*

Departure from Mexico—Passage to Havannah and Philadelphia—
Return to Europe—Results of the Journeys in America.

CHAPTER
XXVII
Departure to
Havannah.

LEAVING the capital of New Spain our travellers descended to the port of Vera Cruz, which is situated among sand-hills, in a burning and unhealthy climate. They happily escaped the yellow fever,—which prevails there and attacks persons who have arrived from the elevated districts as readily as Europeans who have come by sea,—and embarked in a Spanish frigate for Havannah, where they had left part of their specimens. They remained there two months; after which they set sail for the United States, on their passage to which they encountered a violent storm that lasted seven days. Arriving at Philadelphia, and afterwards visiting Washington, they spent eight weeks in that interesting country, for the purpose of studying its political constitution and commercial relations. In August 1804 they returned to Europe, carrying with them the extensive collections which they had made during their perilous and fatiguing journeys.

Arrival at
Philadelphia.

Results of the
expedition.

The results of this expedition, conducted with so much courage and zeal, have been of the highest importance to science. With respect to natural history, it may be stated generally, that the mass of information already laid before the public, as obtained from the

observation of six years, exceeds any thing that had been presented by the most successful cultivators of the same field during a whole lifetime. Much light has been thrown on the migrations and relations of the indigenous tribes of America, their origin, languages, and manners. The *Vues des Cordillères et Monumens des Peuples Indigènes de l'Amérique*, 2 vols. folio, published in 1811, contains the fruit of researches into the antiquities of Mexico and Peru, together with the description of the more remarkable scenes of the Andes. It has been translated into English by Mrs H. M. Williams. The animals observed have been described in a work entitled *Recueil d'Observations de Zoologie et d'Anatomie Comparées, faites dans un Voyage aux Tropiques*, 2 vols. 4to.

CHAPTER
XXVII.
—
American
ethnology.

In the department of Botany the most important additions have been made to science. Our travellers brought with them to Europe an herbarium consisting of more than six thousand species of plants, and Bonpland's botanical journal contained descriptions of four thousand. The valuable works on this subject, that have appeared in consequence of the journey to America, form a new era in the history of botany. They are as follow :—

1. *Essai sur la Géographie des Plantes, ou Tableau Physique des Régions Equinoxiales, fondé sur des Observations et des Mesures faites depuis le 10me degré de latitude australe, jusq'au 10me degré de latitude boréale.* 4to. Works on
the subject.
2. *Plantes Equinoxiales recueillies au Mexique, dans l'Ile de Cuba, dans les Provinces de Caracas, de Cumana, &c.* 2 vols. fol.
3. *Monographie des Melastomes.* 2 vols. fol.
4. *Graminées Rares de l'Amérique Equinoxiale.* 1 vol. fol.
5. *Famille des Mimosas et autres Plantes Legumineuses.* 1 vol. fol.
6. *Nova Genera et Species Plantarum.* 7 vols. fol., containing 700 plates; with a Synopsis in 4 vols. 8vo.

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—
Geography
of Plants.

7. *De Distributione Geographica Plantarum secundum Cœli Temperiem et Alitudinem Montium prolegomena.* 8vo.

The Essay on the Geography of Plants presents a general view of the vegetation, zoology, geological constitution, and other circumstances, of the equinoctial region of the New Continent, from the level of the sea to the highest summits of the Andes. The second work is by M. Bonpland, and contains methodical descriptions, in Latin and French, of the species observed; together with remarks on their medicinal properties and their uses in the arts. The Monography of the Melastomæ, which is also from the pen of M. Bonpland, contains upwards of 150 species of these plants, with others collected by M. Richard in the West Indies and French Guiana.*

In his *Essai Géognostique sur le Gisement des Roches dans les deux Hémisphères*, published in 1826, and translated into English, Humboldt presents a table of all the formations known to geologists, and institutes a comparison between the rocks of the Old Continent and those of the cordillera of the Andes.

Astronomical
observations.

The astronomical treatises have been published in two quarto volumes, under the title of *Recueil d'Observations Astronomiques et de Mesures exécutées dans le Nouveau Continent*. This work contains the original observations made between the 12th degree of south latitude and the 41st degree of north latitude, transits of the sun and stars over the meridian, occultations of satellites, eclipses, &c.; a treatise on astronomical refractions under the torrid zone, considered as the effect of the decrement of caloric in the strata of the atmosphere; the barometric measurement of the Andes of Mexico, Venezuela, Quito, and New Grenada; together with a table of nearly 700 geographical positions. The greatest pains have been taken to verify the calculations. Our author presented to the *Bureau des Longitudes* his astronomical observa-

* The works marked 4, 5, and 6 above, have been prepared by M. Kunth, one of the directors of the Botanical Garden of Berlin.

tions on the lunar distances and the eclipses of Jupiter's satellites, together with the barometrical elevations, which have been calculated and verified by M. Prony according to the formulæ of La Place.

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In 1817 Humboldt laid before the *Académie des Sciences* his map of the Orinoco, exhibiting the junction of that river with the Amazon by means of the Casiquiare and Rio Negro.

Geographical
observations.

The brief account of New Spain which is presented in the preceding pages has been extracted from the *Essai Politique sur la Nouvelle Espagne*, originally published in 2 vols. 4to, and translated into English. With respect to Humboldt's translators it may be remarked, that their want of scientific knowledge, and more especially of natural history, renders the English very much inferior to the French editions.

Most of the above-mentioned publications have appeared in the names of both travellers. The various works relating to the journey will make, when complete, twenty-eight volumes, of which seventeen are in folio and eleven in quarto. The detailed narrative of the expedition occupies four of these volumes; but an octavo edition has also been published under the title of *Voyage aux Régions Equinoxiales du Nouveau Continent, pendant les années 1799, 1800, 1801, 1802, 1803, et 1804*. The translation of this work by Mrs Williams is familiar to the English reader.

Extensive
publications.

The labour necessary for reducing the observations made by our travellers to a condition fit for the public eye must have been very great; yet, possessed of a mind not less characterized by activity than the vastness of its acquirements, Humboldt in the mean while engaged in various investigations, which he has partly published in the foreign journals. In concert with M. Gay Lussac, with whom he lived for several years in the most intimate friendship, he has made numerous magnetic experiments, and verified Biot's theory respecting the position of the magnetic equator. They have found that the great

Great liter-
ary labour.

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- mountain-chains, and even the active volcanoes, have no appreciable influence on the magnetic power; and have established the fact, that it gradually diminishes as we recede from the equator.
- Promotion of Bonpland.** On the return of the philosophers from America, Bonpland was appointed by Bonaparte to the office of superintending the gardens at Malmaison, where the Empress Josephine, who was passionately fond of flowers, had formed a splendid collection of exotics. His amiable disposition, not less than his acquirements, procured for him the esteem of all who knew him. In 1818 he went to Buenos Ayres as Professor of Natural History. In 1820 he undertook an excursion to the interior of Paraguay; but when he arrived at St Anne on the eastern bank of the Parana, where he had established a colony of Indians and a tea-plantation, he was unexpectedly surrounded by a large body of soldiers, who destroyed the plantation and carried him off a prisoner. This was done by the orders of Dr Francia, the ruler of Paraguay; and the only reason assigned was his having planted the tea-tree peculiar to that country, and which forms a valuable article of exportation. He was confined chiefly in Santa Martha, but was allowed to practise as a physician. Humboldt applied in vain for the liberation of his friend, for whom he appears to have cherished a sincere affection. According to a late report, however, he has obtained his liberty.
- Return to America.**
- Imprisonment.**
- Humboldt's visit to London.** In October 1818 our author was in London, where it was said that the allied powers had requested him to draw up a political view of the South American colonies. In November of the same year the King of Prussia granted him an annual pension of 12,000 dollars, with the view of facilitating the execution of a plan which he had formed of visiting Asia, and especially the mountains of Thibet. In the year 1822 he accompanied his majesty to the congress of Verona, and afterwards visited Venice, Rome, and Naples; and, in 1827 and 1828, delivered at Berlin a course of lectures on the physical constitution

of the globe, which was attended by the royal family and the court. But, excepting the results of his investigations, which have appeared at intervals, we have no particular account of his occupations until 1829, when he undertook another important journey to the Uralian Mountains, the frontiers of China, and the Caspian Sea.

CHAPTER
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Journey to
Asia.

CHAPTER XXVIII.

Journey in Central Asia.

Qualifications as a Traveller—Great Designs—Invitation by the Emperor of Russia—Uralian Mountains—Ores—Volcanic Phenomena—Geological Observations—The Chinese Frontier—Relations of Plains and Mountain Systems—Depth of the Sea—Climatology—Ethnology—Altaic Mountain Range—Thian Chan—Himalaya System—Lunar Phenomena—Isothermal Zones—Magnetic Currents—Conclusion.

CHAPTER
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Qualifications of Humboldt.

Value of his services.

Comparison with British travellers.

THE previous narrative has sufficed to show how indomitable is the energy and perseverance, and how remarkable are the qualifications which Humboldt possesses as a scientific traveller. With all the love of travel which frequently springs only from the same adventurous spirit that can find its reward in the chase, or the sports of the field, he possesses the intelligent and patient perseverance which can master every detail requisite for the purposes of science. Still more, he has ever been bent on carrying out scientific induction to its legitimate conclusions, and establishing general laws. In this respect his services have been of immense value to science, and it was from a desire of securing the most ample scope for the necessary comparison of phenomena, and accumulation of facts, that, so soon as he had completed his observations on the continent of America, he sought to make the same minute investigation of the parallel scenes of Northern and Central Asia.

A distinguished critic and historian, Dr. Archibald Alison, has recently remarked, when contrasting the general inferiority of British travellers, with the remarkable men produced by various continental nations, and

especially with Humboldt, Chateaubriand, and Lamar-
 tine :—"It is impossible to contemplate the works of
 these great men without arriving at the conclusion, that
 it is in the varied and discursive education of the conti-
 nent that a foundation has been laid for the extraordi-
 nary eminence which its travellers have attained. It is
 the vast number of subjects with which the young men
 are in some degree made acquainted at the German uni-
 versities, which has rendered them so capable in after
 life of travelling with advantage in any quarter of the
 globe, and writing their travels with effect. This advan-
 tage is in a peculiar manner conspicuous in Humboldt,
 whose mind, naturally ardent and capacious, had been
 surprisingly enlarged and extended by early and various
 study in the most celebrated German universities. He
 acquired, in consequence, so extraordinary a command of
 almost every department of physical and political sci-
 ence, that there is hardly any branch of it in which facts
 of importance may not be found in his travels. He
 combined, in a degree perhaps never before equalled in
 one individual, the most opposite, and generally deemed
 irreconcilable, mental qualities. To an ardent poetical
 temperament, and an eye alive to the most vivid im-
 pressions of external things, he united a power of elo-
 quence rarely given to the most gifted orators, and the
 habit of close and accurate reasoning which belongs to
 the intellectual powers adapted for the highest branches
 of the exact sciences. An able mathematician, a pro-
 found natural philosopher, an exact observer of nature,
 he was at the same time a learned statistician, an indefa-
 tigable social observer, an unwearied philanthropist,
 and the most powerful describer of nature that perhaps
 ever undertook to portray her great and glorious features.
 It is this extraordinary combination of qualities that
 render his works so surprising and valuable. The intel-
 lectual and imaginative powers rarely coexist in remark-
 able vigour in the same individual ; but when they do,
 they produce the utmost triumphs of the human mind."

CHAPTER
XXVIIIContinental
travellers.Peculiar
advantages
of HumboldtCombination
of powers

CHAPTER
XXVIII.

Longings.

Unaccom-
plished plans.Published
works.Great
designs.

Obstacles.

The insatiable longings of Humboldt for access to new and sufficiently ample fields of research have already been referred to. Disappointed in his earlier plan for travelling through Egypt and the East, he visited Spain, in the hope of being able to pass from thence to Africa, when he obtained permission to explore the far more extended field of research in Central America, the fruits of which are narrated in the previous chapters. After commenting on the valuable results which science has reaped from the labours and researches of Humboldt in South America, Dr. Alison remarks:—"The remainder of Humboldt's life has been chiefly devoted to the various and important publications, in which he has embodied the fruit of his vast and extensive researches in the New World. In many of these he has been assisted by M. Aimé Bonpland, who, his companion in literary labour as in the danger and fatigues of travelling, has, with the generosity of a really great mind, been content to diminish, perhaps destroy, his prospect of individual celebrity, by associating himself with the labours of his illustrious friend. Pursued even in mature years by the desire of fame, the thirst for still greater achievements, which belongs to minds of the heroic cast, whether in war or science, he conceived, at a subsequent period, the design of visiting the upper provinces of India and the Himalaya range. After having ascended higher than man had yet done on the elevated ridges of the New World, he was consumed with a thirst to surmount the still more lofty summits of the Old, which have remained in solitary and unapproachable grandeur since the waves of the Deluge first receded from their sides. But the East India Company, within whose dominions, or at least beneath whose influence, the highest ridges of the Himalaya are situated, gave no countenance to the design, and even, it is said, refused liberty to the immortal naturalist to visit their extensive territories."

How far the proceedings ascribed to the merchant rulers of British India affected the plans of the great

traveller we are not prepared to say. Their jealousy of the schemes of conquest entertained by some of the European powers, were not unlikely to stimulate them even to such an excess of care, yet it is hardly conceivable that Humboldt's desire was pressed with any urgency upon them, or it would certainly have met with a more creditable reception, had circumstances permitted, of its fulfilment. The state of the political world, however, was by no means favourable to travel or research by a European, in the regions surrounding the Himalaya range, during the earlier years of the present century. An intelligent writer has remarked in referring to the same subject :— "At two different periods of his life Baron Humboldt cherished the hope of penetrating into the interior of Asia. During the reign of the Emperor Alexander, and under the ministry of Count Romanzoff, he was invited to accompany the embassy which was about to be sent to Thibet by the route of Kachghar and Yarkand ; but the war which burst out in 1812, prevented the execution of this vast enterprise. Notwithstanding this disappointment, our author devoted several years to the study of the Persian language, in the expectation of being able to travel into India by Teheran or Herat, and he examined all the accessible documents which throw any light upon the orography and climatology of the whole of Asia. These labours and researches, though at first only of a preparatory character, were afterwards greatly extended, when, on the invitation of the Emperor of Russia in 1829, he performed his celebrated journey to the Ural mountains, the Altaian range, and the Caspian Sea."

CHAPTER
XXVIIIPolitical im-
pediments.Russian
invitation to
travel.

It is this journey that we now propose to give the reader some account of. The invitation of the Emperor of Russia was chiefly directed to a mineralogical tour to the North of Asia and the Caspian Sea. But such an object promised also ample opportunities for gratifying the desire Humboldt had long entertained of visiting the East, and exploring its whole physical character. Accompanied by

Asiatic
journey.

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M. Ehrenberg, the celebrated naturalist, and Gustavus Rose, no less famed as a chemist, he embarked at Nijnei-Nov-gorod, on the Volga, and descended to Kasan and the Tartar ruins of Bolgari. Thence they went by Perm to Ekatherinenberg, on the Asiatic side of the Uralian Mountains, a vast chain composed of several ranges running nearly parallel to each other, of which the highest summits scarcely attain an elevation of 4593 or 4920 feet, but which, like the Andes, follows the direction of a meridian, from the tertiary deposites in the neighbourhood of Lake Aral to the greenstone rocks in the vicinity of the Frozen Sea. A month was occupied in visiting the central and northern parts of these mountains, which abound in alluvial beds containing gold and platina, the malachite mines of Goumeschevskoi, the great magnetic ridge of Blagodad, and the celebrated deposites at Mourzinsk, in which topaz and beryl are found. Their mineralogical investigations were rewarded with results of the greatest practical value. Besides the precious metals and gems already mentioned, they found the zircon, ruby, garnet, anatase, and ceylanite. Near Nijnei-Tagilsk, a country which may be compared to Choco in South America, a mass of platina has been found weighing nearly 22 pounds troy. The osmiuret of iridium has also been discovered ; and though they did not personally disinter the diamond, yet their observations have since led to its discovery. "In 1826, Professor Engelhardt predicted that diamonds would be found in the alluvium on the Urals, which strikingly resembled that of Brazil, containing diamonds. Humboldt saw the same similarity between the Ural and Brazilian mountains, but though the sand washed for gold was examined in his presence, no diamonds were found. Count Polier however, after separating from the Baron, repaired to the possessions of his lady, on the western side of the Urals, and discovered the first Ural diamond. Other diamonds were afterwards found, equal in beauty to those of Brazil."

Uralian
mountains.Gold and
platina.

Gems.

Diamonds in
the Urals.

It was Humboldt and his companions, however, who personally discovered the remarkable mass of platina referred to, and they were also successful in finding in the vicinity of Miask, three masses of native gold, two of which weighed 18. 36, and the third 28. 36 pounds troy.

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XXVIII.
Discovery of
platina.

Soon after Humboldt's return from his Asiatic expedition he published an account of his researches in his *Fragmens Asiaticques*. This work extended to two volumes, but though it contained a great mass of valuable information, it included only a very small proportion of the results of his observations. When a second edition was called for, he adopted a new, and much more extended form, embracing the conclusions arrived at by study and investigation during the intervening period, and also included a systematic view of Asiatic geology. He thus intimates the limits which he assigned to himself in the treatment of the subject. "In publishing this new work, a part of my studies in Asia, it was not my intention to delineate a physical picture, the different parts of which bore a due proportion to each other. I have confined myself to the most correct and recent information respecting the irregularities in the surface of the ground, and the influence which they have on the constitution of the atmosphere, under the double aspect of its temperature and dryness. As I still cherish the hope of publishing a very general work under the imprudent title of *Kosmos*, I confined myself by preference, in my *Central Asia*, to the subject of terrestrial physics."

Fragmens
Asiaticques

New Asiatic
work.

The extent of country explored by Baron Humboldt and his companions afforded ample opportunities for the most varied observations of the phenomena of nature. From Jekatherinenburg they proceeded by Tioumen to Tobolsk on the Irtisch, and thence by Tara, a steppe or desert of Baraba, which is dreaded on account of the torments caused by the multitudes of insects belonging to the family of *Tipula*, to Barnaoul on the banks of the Ob; the picturesque lake of Kolyvan; and the rich

Course of
travel.

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silver-mines of Schlangenberg, Riddersk, and Zyrianovski, situated on the south-western declivity of the Altaic range, the highest summit of which is scarcely so elevated as the Peak of Teneriffe. The mines of Kolyvan produce annually upwards of 49,842 troy pounds of silver.

Route to the Chinese frontier.

Proceeding south-ward from Riddersk to Oust-Kamenogorsk, they passed through Boukhtarminsk to the frontier of Chinese Zungaria. They even obtained permission to cross the frontier, in order to visit the Mongol post of Baty, or Khonimailakhou, northward of the Lake Dzaisang. After visiting the steppe of the Middle Horde of the Kirghiz, and reaching the southern part of the Ural, where the masses of gold referred to above were found, they passed by Gonberlinsk to Orenburgh, which, notwithstanding its distance from the Caspian Sea, is below the level of the ocean, and then visited the famous salt-mine of Iletzki, situated in the steppe of the Little Kirghiz Horde. They afterwards inspected the principal place of the Ouralsk Cossacks; the German colonies of the Saratov government on the left bank of the Volga; the great salt lake of Elton in the steppe of the Kal-mucks; a fine colony of Moravians at Sarepta; and, finally, arrived at Astracan. The principal objects of this excursion to the Caspian Sea were, the chemical analysis of its waters, which Mr. Rose intended to make; the observation of the barometrical heights; and the collection of fishes for the great work of Baron Cuvier and M. Valenciennes.

Salt mine of Iletzki.

Return to Moscow.

From Astracan the travellers returned to Moscow, by the isthmus which separates the Don and the Volga, near Tichinskaya, and the country of the Don Cossacks.

Qualifications of Humboldt.

The knowledge acquired by Humboldt in his exploration of Central America furnished him with means of comparison and analysis, such as no other traveller, or scientific observer, ever possessed before. He is thus enabled to point out the analogies or differences between the great mountain ranges of Asia, the European Alps,

and the Cordilleras of the New World, and to furnish data from whence to deduce some of the laws which govern the most remarkable phenomena of the globe. In following out the great plan which he had set himself, Baron Humboldt has devoted the two first volumes of his work to an elaborate treatise on the peculiar phenomena attendant on the upheaval of continents, and the remarkable geological changes which have produced the great mountain chains, and the other striking physical conformations of the earth's crust. His Memoir on the Mountain Chains and the Volcanoes of Central Asia possesses very great attractions to the student of science, though much of the work, and the mode of treating the very comprehensive subjects which it includes, renders it too strictly scientific to offer the attractions which Humboldt's personal narrative possesses for the general reader. The following abstract will afford some idea of the earlier portion of this valuable work.

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XXVIII.

Geological
changes.

In our present state of knowledge, volcanic phenomena are not to be considered as relating peculiarly to the science of geology, but rather as a department of general physics. When in action they appear to result from a permanent communication between the interior of the globe, which is in a state of fusion, and the atmosphere which envelopes the hardened and oxidated crust of our planet. Masses of lava issue like intermittent springs; and the superposition of their layers which takes place under our eyes bears a resemblance, on a small scale, to the formation of the ancient crystalline rocks. On the crest of the cordilleras of the New World, as well as in the south of Europe and the western parts of Asia, an intimate connexion is manifestly traceable between the chemical action of volcanoes properly so called, or those which produce rocks,—their form and position permitting the escape of earthy substances in a state of fusion,—and the mud-volcanoes of South America, Italy, and the Caspian Sea, which at one period eject fragments of rock, flames, and acid vapours, and at another vomit muddy

Volcanic
phenomena.

Uniformity
of results.

Mud
volcanoes.

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clay, naptha, and irrespirable gases. There is even an obvious relation between the proper volcano and the formation of beds of gypsum and anhydrous rock-salt, containing petroleum, condensed hydrogen, sulphuret of iron, and, occasionally,—as at Rio-Kualloga to the east of the Peruvian coasts,—large masses of galena and sulphuret of lead; the origin of hot springs; the arrangement of metallic deposits; earthquakes, which are ever and anon accompanied by chemical phenomena: and the sometimes sudden, and the sometimes very slow, elevations of certain parts of the earth's surface. It is during these great changes in the earth's crust that the most of the metalliferous deposits have occurred which now form so valuable a source of economic wealth. The altered rock, split into crevices, and, changed by the action of heat has been anew filled up and agglomerated by the metals forced upwards from nature's great laboratory into these cracks which become the metalliferous veins. An intelligent, scientific writer, in reviewing Baron Humboldt's "Researches in Central Asia," has remarked:—"The study of these interesting phenomena, leads us to general views of the catastrophes which have taken place in times which preceded the historic era. The action of the interior of a planet upon its outer crust, varies with the stages of its progressive cooling, and with the inequalities in the solidity and fluidity of the matters which compose it. In our day this action is greatly enfeebled; it is confined to a small number of points. It is intermittent, and less frequently displaced, and only produces rocks, round small circular apertures, or longitudinal crevices of small extent. It never exhibits its power at great distances, excepting in shaking the crust of the earth in linear directions, or in circles of simultaneous oscillations, which continue the same for many centuries. In these primeval ages, says Humboldt, the elastic fluids or volcanic forces of our earth, more energetic than at present, have made their way through the oxidated and slightly solidified crust of our planet.

Hot springs.

Metalliferous
deposits.General
views.Enfeebled
volcanic
actions.

It was then they produced cracks in this crust, and filled them not only with dykes, but with shapeless masses of matter of great density, such as ferruginous basalts, greenstones, and masses of metal, materials which were introduced subsequently to the solidification and flattening of the planet. The epoch of great geological revolutions, was that when the communication between the fluid interior of the earth and its atmosphere were the most frequent—when they acted upon a greater number of points—when the tendency to establish these communications has upheaved, (at different epochs, and by different kinds of action), upon long crevices,—cordilleras, like the Himalaya and the Andes, or chains of mountains of less elevation, or finally those ridges and heights whose varied undulations embellish the landscape of our plains. It is as the witness of these upheavals, and marking (after the grand and ingenious views of M. Elie de Beaumont) the relative age of the mountains I have seen in the Andes of the New world, at Cundinamara,—of extensive formations of grit, stretching over the plains of Magdalena and Meta almost uninterruptedly, in plateaus about 9000 feet high, that I have found still more recently in the north of Asia, in the chain of the Ural, the same bones of antediluvian animals, (so celebrated in the lower regions of the Koma and the Irtyche), mixed on the back of the chain, and in the plateaus between Beresovsk and Ekaterinbourg with earths rich in gold, diamonds, and platina. It is also as a witness of the subterranean action of elastic fluids which raise continents, mountain chains, and insulated domes—which displace rocks, and the organic debris which these rocks contain—which produce heights or hollows as the vaults crumble down, that we ought to consider the *great depression* which the west of Asia presents to us. The surface of the Caspian Sea, and of the Lake Aral, forms the lowest part of it; but the depression extends itself far into the interior of the country beyond the Sarepta, as at the Lake of Elton, and at the steppes of Bogdo, be-

CHAPTER
XXVIIIPeriod of
action.Relative age
of monu-
tains.Bones of
antediluvian
animals.Area of
depression.

CHAPTER
XXVIII.Traces in
Europe and
Asia.Elucidation
of problems
science.Operation of
internal
forces.Previous
actions.

tween the Wolga and the Jaik. The depression of a mass of continent 80 feet below the surface of the waters of the ocean, in their mean state of equilibrium, has never been considered in all its importance, because we are ignorant of the extent of this depression, of which some parts of the coasts of Europe and Egypt (in Holland, and at the Natron lakes) present only feeble traces."

This intimate connexion between these diversified appearances is now serving to elucidate many problems in geology and physics which had previously been considered inexplicable. The analogies of observed facts, and the strict investigation of phenomena of recent occurrence, gradually lead us to more probable conjectures as to the events of those remote periods which preceded historical records. The influence which the forces in the interior of our planet exercise upon its external envelope in the various stages of its refrigeration, on account of the unequal aggregation in which its component substances occur, is at the present day in a very diminished condition. These forces appear now to be restricted to a small number of points; intermittent; simplified in their chemical effects; producing rocks only around small circular apertures, or over longitudinal cracks of small extent; and manifesting their power, at great distances, only dynamically, by shaking the crust of our planet in linear directions, or in spaces which remain the same during a great number of ages. Previous to the existence of the human race, the action of the interior of the globe upon the solid crust, which was increasing in volume, must have modified the temperature of the atmosphere, and rendered the whole surface capable of giving birth to those productions which are now regarded as exclusively tropical: since that time, by the effect of the radiation and refrigeration of the exterior, the relations of the earth to a central body, the sun, began almost exclusively to determine the diversity of geographical latitudes, and to give their present character to the various climates of the earth's zones.

There is something extremely fascinating in the view thus afforded us of the great work-shop and laboratory of nature as it may be justly called. We see the volcanic powers of the central earth at work, their hidden fires fusing and changing the materials of which it is composed, and the elastic fluids traversing the oxidated and solidified crust of the globe, intersecting this crust with crevices, and injecting it with masses and veins of basalt, metallic substances, and other matters, introduced after the solidificating of the planet had been completed. The period of the great geological changes which we are now considering, is shown to have been that when the communication of the fluid interior of the planet and its atmosphere were frequent, and gave rise, in the line of the long crevices, to the cordilleras of the Andes and Himalaya Mountains, and the ridges whose undulations embellish the landscape of tamer scenery. It is as proofs of these protrusions that Humboldt refers to the sandstone formations which extend from the plains of the Magdalena and Meta, over platforms having an elevation varying from 8950 to 10,232 feet; and to the bones of antediluvian animals intermingled on the summit of the Uralian chain of North Asia with transported deposits, containing gold, diamonds, and platina. Another evidence of this subterranean action of elastic fluids is the great depression of the land already referred to, which occurs in the west of Asia, of which the Caspian Sea and the Lake Aral form the lowest part many feet beneath the level of the ocean, but which extends far into the interior of the continent, stretching to Saratov and Orenburg on the Jaik, and probably to the south-east as far as the lower course of the Sihon (Jaxartes) and the Amou (the Oxus of the ancients). This depression of a continental mass extending to 80 feet below the surface of the ocean in its mean state of equilibrium, has not hitherto obtained the necessary consideration which its importance demands, because it was not sufficiently known.

CHAPTER
XXVIIICentral
powers.Period of
great
changes.Evidence of
protrusions.Great Asiatic
depression.

CHAPTER
XXVIIIUpheaval of
mountains.

Baron Humboldt, after a careful exploration of the country, and a comparison of its features with those which he had previously investigated in the New World, arrives at the conclusion that it has an intimate connexion with the upheaving of the Caucasian Mountains, those of Hindoo-kho, and of the elevated plain of Persia which borders the Caspian Sea and the Mavar-ul-Nahar to the south ; and, perhaps, more to the eastward, with the elevation of the great mass of land, which is designated by the vague and incorrect name of the central plain of Asia. This concavity he considers as a crater-country, similar to the Hipparchus, Archimedes, and Ptolmey, of the moon's surface, which have a diameter of more than 100 miles, and which may be rather compared with Bohemia than with our volcanic cones and craters.*

Passage of
the Chinese
frontiers.

In the course of this journey of Baron Humboldt, in company with MM. Ehrenberg and Rose, he passed, in seven weeks, over the frontiers of Chinese Zungaria, between the forts of Oust-Kamenogorsk, and Boukhtarminsk, and Khonimailakhou (a Chinese post to the north of the Lake Dzaisang), the Cossach line of the Kirghiz steppe, and the shores of the Caspian Sea. In the important commercial towns of Semipolatinsk, Petropauluska, Troitzkaia, Orenburg, and Astracan, he obtained from Tartars, Bucharrians, and Tachkendis, information respecting the Asiatic regions in the vicinity of their native country. At Orenburg, where caravans of several thousand camels annually arrive, an enlightened individual, M. de Gens, has collected a mass of materials of the highest importance for the geography of Central Asia. Among the numerous description of routes communicated by this person, our author found the following

Geographical
data.

* It appears, however, that Professor Parrot, on the authority of whose barometrical measurements, made in 1811, this opinion was originally adapted, has since been led to doubt its accuracy. In fact, from observations made by him in 1829 and 1830, he has found the mouth of the Don, which enters the Black Sea, to be between three and four feet lower than that of the Volga, which empties itself into the Caspian.

remark :—" In proceeding from Semipolatinsk to Jerkend, when we were arrived at the Lake Ala-koul or Ala-dinghiz, a little to the north-east of the great Lake Balkachi, which receives the waters of the Ele, we saw a very high mountain which formerly vomited fire. Even now this mountain, which rises in the Lake like a little island, occasions violent storms which incommode the caravans. For this reason some sheep are sacrificed to this old volcano by those who pass it."

Old volcano.

This account which was obtained from a Tartar who travelled at the commencement of the present century, excited a lively interest in the mind of Humboldt, more especially as it suggested some probable authority for the accounts of burning volcanoes in the interior of Asia, made known through the researches of Abel Rémusat and Klaproth in Chinese books, and the great distance of which from the sea has excited so much surprise. Soon after his departure from Petersburg he received from M. de Klosterman, imperial director of police at Semipolatinsk, the following particulars which were obtained from Bucharrians and Tachkendis :—

Interesting inquiries.

"The route from Semipolatinsk to Kouldja is twenty-five days. It passes by the mountains Alachan and Kondegatay, in the steppe of the Middle Horde of the Kirghiz the borders of the Lake Savande-koul, the Tarbagatai Mountains in Zungaria, and the river Emyl. When it has been traversed, the road unites with that which leads from Tchougeutchak to the province of Ele. From the banks of the Emyl to the Lake Ala-koul the distance is 39½ miles. The Tartars estimate the distance of this lake from Semipolatinsk at 301 miles. It is to the right of the road, and extends from east to west 66½ miles. In the midst of this lake rises a very high mountain named Aral-toube. From this to the Chinese post, situated between the little Lake Janalache-koul and the river Baratara, on the banks of which reside Kalmucks, are reckoned 36 miles."

Information collected.

It is evident that the same mountain is alluded to in

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both these accounts ; and with the view of connecting it with the volcanoes discovered by Klaproth and Abel Rémusat mentioned in very ancient Chinese books, as existing in the interior of Asia, to the north and south of Teen-shaw.

Plains and
mountain
systems.

In the succeeding section of this work on Central Asia, Baron Humboldt supplies an exceedingly interesting and valuable account of the general character and relative features of the great plains and mountain systems of the continent of Asia. In no portion of his researches are the great value of his varied acquirements and extended observations more apparent. Not only does he deduce from his investigations of these external features

Natural laws.

of our planet, new illustrations of the laws which govern its internal constitution, and produce those great commotions of which the vast mountain chains and concavities are results, but he also shows the permanent influence which they have exercised on the distribution of planets and animals over the globe, on the repartition of heat throughout the different seasons, and on many of the meteorological changes which exercise so important an influence on climate, and on animal and vegetable life.

Influence on
early migra-
tion.

Their very direction appears to have largely affected the earliest migrations of the human race, and no doubt also guided the course pursued in the divergence of animal life of every degree from the original Asiatic centre to which sacred history and modern science alike point as the scene of creation.

Systematic
views of
Humboldt.

In pursuing his investigations into the physical phenomena of the Asiatic continent, Baron Humboldt has aimed at reducing these to their most simple elements. He has accordingly, in considering the plains and mountain systems of Asia, regarded Europe as a part of it, setting aside what are fully as much political as physical lines of demarcation, he regards Europe as a peninsular prolongation of Asia, which from the extent of the surface over which the conjunction is prolonged, affords abundant opportunity for the continuation of the same

structural system throughout the whole. The same singularly monotonous aspect pervades the vast area extending from Westphalia to the banks of the Obi and the Lena. The great plains are evidently the primitive structures upheaved by some prolonged but uniform action extending over an extremely wide area. Upon this the chains of mountains have been superinduced by subsequent upheavals, acting more irregularly over a more limited surface. The direction of south-west by north-east is, however, traceable alike in the principal axes of these vast elevated plateaus, and in the chains of mountains of later formation; so that a connexion appears thus traceable in the sources of these successive upheavals, though productive of results so very different. The influence of the geological features resulting from these combined actions is very remarkable. The effect of these elevated plateaus, with their systems of mountain chains, is specially noticeable in relation to climate, and consequently to the distribution of the vegetable kingdom, to the nature of the animals located on their surface, and no less so to the physical and mental peculiarities of the large portion of the human race settled within these districts.

CHAPTER
XXVIII.
Great plains.

Sources of
upheavals.

Leaving this extremely interesting branch of the inquiry which relates to the distribution of life in all its various forms as exhibited in the animal and vegetable kingdoms and in man himself, the observant traveller next proceeds to examine the relative connections of the area of the plains, and the area of the chains of mountains, and deduces from thence important conclusions in relation to the centre of gravity of that portion of our planet which is elevated above the present level of the sea. This subject had already excited much interest in the minds of various distinguished European scientific men, well qualified to investigate such phenomena, but possessed of very limited opportunities of comparison and observant study, when contrasted with those which Humboldt has commanded during his sojourn on the

Relations of
plains and
mountain
systems.

CHAPTER XXVIII. continents both of America and Asia. The results of one branch of Humboldt's elaborate investigations are summed up in the following comparative statement of all the observed areas of the Old and New World :—

Mean heights.	Area in Square Marine Leagues.	Mean height of the centre of gravity in English feet.
North America,	607,000	. 750
South America,	571,000	. 1132
All America,	1,178,000	. 934
Asia,	1,346,000	. 1152
Europe,	304,000	. 672

Mean depth of sea.

Laplace had drawn the conclusion from his more limited opportunities of observation and comparison, that the mean depth of the sea nearly corresponded with the mean height of continents and islands above its level. Following out a naturally assumed analogy, he also concluded that there must be great cavities in the sea, corresponding to the lofty mountains on the surface of the earth; though, at the same time, he conceived that, owing to the constant depositions of rivers, the denudations of currents, and the shifting of sands, as well as the accumulation of the exuvial of marine animals, it seemed likely the original extreme depth of such cavities would be considerably decreased. It will be seen, however, that the investigations of Humboldt have led to very different conclusions. According to Laplace, the mean height of the continental regions of our globe above the level of the sea, should be found to be 3284 feet, whereas Humboldt assigns satisfactory reasons for concluding that it cannot greatly exceed 1020. Not only does this conclusion show Laplace's results to have been considerably upwards of two-thirds in excess of the true phenomena of relative elevation, but it still more remarkably disagrees with his ideas as to the true arrangement and comparative depths of the bed of the ocean. Numerous important observations have been made of late years by able

Conclusions of Laplace.

Extent of error.

practical seamen on the actual depths of the ocean ; and soundings have been made to a depth of 8540 feet without finding a bottom ; so that, so far from the ocean being only a repetition, in an inverse ratio, on an inferior scale, of relative depressions corresponding to the elevation on the earth's surface, it seems now probable that the bed of the ocean exceeds in depth, by five or six times, the elevation of the earth's heights.

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Soundings
of the ocean.

Many of the most remarkable investigations pursued by Humboldt, as the results of his study of the phenomena noted by him during his residence on the Asiatic continent, are of so complex and abstruse a nature, as to render it extremely difficult to reduce them to a popular form. The conclusions, however, are in all cases remarkable, and frequently of great practical value. Remarkable on the singularity and uniformity of arrangement discoverable in the mountain systems of Asia, our traveller points out their apparent natural subdivision into four systems, all running from west to east, along the greatest breadth of the surface of the land ; while these, again, are crossed by other mountain chains having a meridional direction. Aiming at the discovery of some clearly pronounced indications of general laws, Humboldt arrives at the conclusion that, in a portion of the Asiatic continent most effectively surveyed by him, a predominance of auriferous and platiniferous deposits is clearly demonstrable in the latter mountain chains, or those having a meridional direction. In these, as in so many others of his most important conclusions as to general laws, Humboldt was greatly assisted by his previous observation of the same class of phenomena, exhibited on so gigantic a scale in the New World. In the Andes, in the southern Alleghanies, and in the mountains of Brazil, all his conclusions pointed to similar results, and led to his adopting the opinion that this remarkable law was demonstrable in regard to the auriferous alluvions of the American continent. Hence the great value of the conclusion, put forth in the "Re-

Abstruse
investiga-
tions.

General
laws.

Phenomena
of the New
World.

CHAPTER
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of previous
labours.

searches in Central Asia," as well as in the previous preparatory work, the "Fragmens Asiatiques."

Humboldt had already been trained by his previous labours, not only as an observer and a collector of facts, but still more, as a detector of those general laws by which the numerous detached indications of such are united into a consistent and harmonious whole. We must not, however, overlook the no less important element of success in the great natural gifts by which he is so peculiarly fitted to become the scientific observer and explorer. Training, and opportunities of observation, were indispensable to him; but without the natural aptitude for his important self-imposed duties, no amount of preparatory training, or means of observing, could have fitted him for those remarkable generalizations by which he detected the operation of laws that govern the temperature of the earth, the variations in its external form and internal construction; the disposition of its mineral wealth; the distribution of its living occupants, both of the animal and vegetable kingdoms; and the temperature of the atmosphere, which exercises so great an influence on most of these phenomena.

Natural
aptitude.

Climatology.

On the general subject of climatology and atmospheric pressure, Humboldt has thus expressed himself in his later work:—"As the most important fluctuations of the pressure of the atmosphere, whether occurring with horary or annual regularity, or accidentally, and then often attended by violence and danger, are, like all the other phenomena of the weather, mainly owing to the heating force of the sun's rays, it has long been suggested that the direction of the wind should be compared with the height of the barometer, alternations of temperature, and the increase and decrease of humidity. Tables of atmospheric pressure during different winds, termed *barometric windroses*, afford a deeper insight into the connection of meteorological phenomena. Dove has, with admirable sagacity, recognised, in the 'law of rotation' in both hemispheres, which he himself established,

the cause of many important processes in the aerial ocean. The difference of temperature between the equatorial and polar regions engenders two opposite currents in the upper strata of the atmosphere, and on the earth's surface. Owing to the difference between the rotatory velocity at the poles and at the equator, the polar current is deflected eastward, and the equatorial current westward. The great phenomena of atmospheric pressure, the warming and cooling of the strata of air, the aqueous deposits, and even, as Dove has correctly represented, the formation and appearance of clouds, alike depend on the opposition of these two currents, on the place where the upper one descends, and on the displacement of the one by the other. Thus the figures of the clouds, which form an animated part of the landscape, announce the processes at work in the upper regions of the atmosphere, and, when the air is calm, the clouds will often present, on a bright summer sky, the 'projected image' of the radiating soil below.

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Effects of
temperature.

Formation
of clouds.

Where this influence of radiation is modified by the relative position of large continental and oceanic surfaces, as between the eastern shore of Africa and the western part of the Indian peninsula, its effects are manifested in the Indian monsoons, which change with the periodic variations in the sun's declination, and which were known to the Greek navigators under the name of *Hippalos*. In the knowledge of the monsoons, which undoubtedly dates back thousands of years amongst the inhabitants of Hindostan and China, of the eastern parts of the Arabian Gulf and of the western shores of the Malayan Sea, and in the still more ancient and more general acquaintance with land and sea winds, lies concealed, as it were, the germ of that meteorological science, which is now making such rapid progress."

Continental
and oceanic
influences.

Monsoons.

Not the least remarkable of the indications afforded, in late years, of the peaceful, but sure triumphs of science, is to be found in the great chain of observatories,—

Observa-
tories.

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Astronomical observatories.

Magnetic stations.

Anticipated results.

Distribution of heat.

the fortresses of science,—spread over so vast a portion of the known world. No longer confining itself to the European centre of civilization, observatories for watching the stars, and extending the established truths relating to the vast system of worlds that glitter in our midnight sky, have been established in Africa and America ; while across the hemispheres, which includes an important portion of the old continents of Asia and Europe, a long continuous chain of magnetic stations has been formed, extending from Moscow to Peking, across the whole of Northern Asia. At these stations, also, complete meteorological observatories are established, so that it can hardly be doubted important truths must result from these, in relation to the great laws of nature, of which these phenomena are only the indices or results. On this Humboldt observes in his *Cosmos* :—“ The comparison of observations made at places lying so many hundred miles apart, will decide, for instance, whether the same east wind blows from the elevated desert of Gobi to the interior of Russia, or whether the direction of the aerial current first began in the middle of the series of the stations, by the descent of the air from the higher regions. By means of such observations we may learn, in the strictest sense, *whence* the wind cometh. If we only take the results on which we may depend from those places, in which the observations on the direction of the winds have been continued more than twenty years, we shall find, that in the middle latitudes of the temperate zone, in both continents, the prevailing aerial current has a west-south-west direction.

“ Our insight into the *distribution of heat* in the atmosphere has been rendered more clear since the attempt has been made to connect together by lines those places where the mean annual summer and winter temperatures have been ascertained by correct observations. The system of *isothermal*, *isothermal*, and *isochimneral* lines, which I first brought into use in 1817, may, perhaps, if it be gradually perfected by the united efforts

of investigators, serve as one of the main foundations of *comparative climatology*. Terrestrial magnetism did not acquire a right to be regarded as a science, until partial results were graphically connected in a system of lines of *equal declination, equal inclination, and equal intensity*."

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The subject of climatology involves an extremely interesting class of phenomena, with their resulting laws,—trade winds, land and sea winds, ocean currents, the changes of seasons, &c. It also includes the investigation of the curious results flowing from the extremely differing rates of variation of land and sea. From the last of these arises the important contrast between insular and littoral climates. "This remarkable contrast has been fully developed by Leopold von Buch in all its various phenomena, both with respect to its influence on vegetation and agriculture, on the transparency of the atmosphere, the radiation of the soil, and the elevation of the line of perpetual snow. In the interior of the Asiatic continent, Tobolsk, Barnaul on the Oby, and Irkutsk, have the same mean summer heat as Berlin, Munster, and Cherbourg in Normandy; the thermometer sometimes remaining for weeks together at 86° or 88°, whilst the mean temperature is, during the coldest month, as low as —0°·4 to —4°. These continental climates have, therefore, justly been termed *excessive* by the great mathematician and physicist, Buffon; and the inhabitants who live in countries having such *excessive* climates seem almost condemned, like the sad expurgated souls in Dante's 'Purgatorio,' to suffer alike the torments of heat and cold.

Climatology.

Differences
of climate.

Excessive
climates.

"In no portion of the earth, neither in the Canary Islands, in Spain, nor in the south of France, have I ever seen more luxuriant fruit, especially grapes, than in Astrachan, near the shores of the Caspian Sea (46° 21'). Although the mean annual temperature is 48°, the mean summer heat rises to 70°, as at Bordeaux, whilst not only there, but also farther to the south, as at Kislar on the

Astrachan.

CHAPTER
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changes of
temperature.

mouth of the Terek, (in the latitude of Avignon and Rimini) the thermometer sinks in the winter to -13° or -22° ."

No less remarkable are the important changes in temperature, animal and vegetable life, &c., produced by relative position, and degrees of elevation. To this, nearly as much as to the comparative distances from the equator and the pole, belong the great variations of temperature, and the changes in the living beings scattered through different portions of the same zone; so that it still remains an unsolved question, whether vast tracts in the interior of the African continent are arid wastes, burnt up by equatorial fires, or elevated plateaus clothed with the rich herbage and occupied by the abundant life of a temperate clime. The Nile, it is now all but proved, rises in mountains covered with eternal snows, and in the supposed torrid centre of the African continent, very recent discoveries have brought to light a vast inland lake, or sea, the source of internal communication, as well as of a more tempered clime. "The same relations," says Humboldt, "which exist between the equable littoral climate of the peninsula of Brittany, and the lower winter and higher summer temperature of the remainder of the continent of France, are likewise manifested, in some degree, between Europe and the great continent of Asia, of which the former may be considered to constitute the western peninsula. Europe owes its milder climate, in the first place, to its position with respect to Africa, whose wide extent of tropical land is favourable to the ascending current, while the equatorial region to the south of Asia is almost wholly oceanic; and next to its deeply articulated configuration, to the vicinity of the ocean on its western shores; and, lastly, to the existence of an open sea, which bounds its northern confines. Europe would, therefore, become colder if Africa were to be overflowed by the ocean; or if the mythical Atlantis were to arise and connect Europe with North America; or if the gulf stream were no

Climates of
Europe and
Africa.

longer to diffuse the warming influence of its waters into the North Sea; or if, finally, another mass of solid land should be upheaved by volcanic action, and interposed between the Scandinavian peninsula and Spitzbergen. If we observe that in Europe the mean annual temperature falls as we proceed, from west to east, under the same parallel of latitude, from the Atlantic shores of France through Germany, Poland, and Russia, towards the Uralian mountains, the main cause of this phenomenon of increasing cold must be sought in the form of the continent, (which becomes less indented, and wider, and more compact, as we advance,) in the increasing distance from seas, and in the diminished influence of westerly winds. Beyond the Uralian mountains, these winds are converted into cool land-winds, blowing over extended tracts covered with ice and snow. The cold of western Siberia is to be ascribed to these relations of configuration and atmospheric currents, and not—as Hippocrates and Trogius Pompeius, and even celebrated travellers of the eighteenth century, conjectured—to the great elevation of the soil above the level of the sea.”

But it is impossible to reduce within limited space, and in a popular form, all the remarkable indications of natural phenomena and great general laws, brought by the extensive researches, and singularly sagacious conclusions of the great traveller.

Humboldt treats, in another of the remarkable works which we owe to his pen, of the sublime phenomena of creation, as illustrated by science. This has been designated “Views of Nature,” and in it, also, he describes some of the most remarkable natural phenomena of the Asiatic continent. In the chapter in which he treats of steppes and deserts, he remarks—“On the mountainous range of Central Asia, between the Gold or Altai Mountain and the Kouen-lien, from the Chinese wall to the further side of the Celestial Mountains, and towards the Sea of Aral, over a space of several thousand miles, extend, if not the highest, certainly the largest steppes in

CHAPTER
XXVIII.Changes of
temperature
in same
parallel of
latitude.Temperature
of Siberia.Extent of
subject.Views of
nature.

CHAPTER
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of the
steppes.Remarkable
height of
flowering
plants.Influence on
population.

the world. I myself enjoyed an opportunity, full thirty years after my South American travels, of visiting the portion of the steppes which is occupied by Kalmuck Kirghis tribes, and is situated between the Don, the Volga, the Caspian Sea, and the Chinese Lake of Dzungar, and which consequently extends over an area of nearly 2800 geographical miles. The vegetation of the Asiatic steppes, which are sometimes hilly, and interspersed with pine forests, is in its groupings far more varied than that of the Llanos and the Pampas of Caracas and Buenos Ayres. The more beautiful portions of the plains, inhabited by Asiatic pastoral tribes, are adorned with lowly shrubs of luxuriant white-blossomed Rosaceæ, Crown Imperials (*Fritillariæ*), *Cypripediæ*, and Tulips. As the torrid zone is in general distinguished by a tendency in the vegetable forms to become arborescent, so we also find, that some of the Asiatic steppes of the temperate zone are characterized by the remarkable height to which flowering plants attain; as, for instance *Saussureæ*, and other *Synantheræ*; all siliquose plants and particularly numerous species of *Astragalus*. On crossing the trackless portions of the herb-covered steppes in the low carriages of the Tartars, it is necessary to stand upright in order to ascertain the direction to be pursued through the copselike and closely-crowded plants that bend under the wheels. Some of the steppes are covered with grass; others with succulent evergreen, articulated alkaline plants; while many are radiant with the effulgence of lichen-like tufts of salt scattered irregularly over the clayey soil like new-fallen snow.

“These Mongolian and Tartar steppes, which are intersected by numerous mountain chains, separate the ancient and long-civilized races of Thibet and Hindostan from the rude nations of Northern Asia. They have also exerted a manifold influence on the changing destinies of mankind. They have inclined the current of population southward, impeded the intercourse of nation

more than the Himalayas, or the Snowy Mountains of Sirinagur and Gorka, and placed permanent limits to the progress of civilization and refinement in a northerly direction.

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“History cannot, however, regard the plains of Central Asia under the character of obstructive barriers alone. They have frequently proved the means of spreading misery and devastation over the face of the earth. Some of the pastoral tribes inhabiting this steppe,—the Mongols, Getæ, Alani, and Usûni,—have convulsed the world. If in the course of earlier ages, the dawn of civilization spread like the vivifying light of the sun from east to west; so, in subsequent ages and from the same quarter, have barbarism and rudeness threatened to overcloud Europe.

Races of
Central Asia.

“A tawny tribe of herdsmen of Tukiuish, *i.e.* Turkish origin, the Hiongnu, dwelt in tents of skins on the elevated steppe of Gobi. A portion of this race had been driven southward towards the interior of Asia, after continuing for a long time formidable to the Chinese power. This dislodgement of the tribes was communicated uninterruptedly as far as the ancient land of the Fins, near the sources of the Ural. From thence poured forth bands of Huns, Avars, Chasars, and a numerous admixture of Asiatic races. Warlike bodies of Huns first appeared on the Volga, next in Pannonia, then on the Marne and the banks of the Po, laying waste those richly cultivated tracts, where, since the age of Antenor, man’s creative art had piled monument on monument. Thus swept a pestilential breath from the Mongolian deserts over the fair Cisalpine soil, stifling the tender, long-cherished blossoms of art!”

The Turkish
race.

The Huna.

Thus remarkably are the features of nature, and the laws which science discloses, intimately blended with the history of the human race, on which the great Creator of the universe has bestowed, as their inheritance, the theatre of the world. It is at all times, indeed, equally instructive and remarkable to contemplate the connexion

History of
the human
race.

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Value of
comprehen-
sive obser-
vation.

which exists among all the sciences, and the light they are calculated to throw on each other. They appear as a connected series of links in the great chain of natural truths, of which one seeker obtains a few detached links here, and another there, but rarely only, and at very remote interval, some man appears of giant mind, such as our great scientific traveller, Alexander von Humboldt, who takes in within his comprehensive grasp a connected series of many links, and discovers somewhat of the perfect unity which ranges throughout the creation, as well as the providential government of God.

Steppes of
Asia and
America.

In contrasting the steppes of Asia with the vast grassy plains of the New World, Humboldt gives the decided preference, in many points, both of interest and beauty, to the former. The Asiatic plains alike excel in beauty of vegetation, and in their rich and varied aspect. In his "Views of Nature," he remarks—"In a great portion of the Kirghis and Calmuck steppes which I have traversed, (extending over a space of 40 degrees of longitude,) from the Don, the Caspian Sea, and the Orenburg-Ural river Jaik, to the Obi and the Upper Irtysch, near the Lake Dsaisang, the extreme range of view is never bounded by a horizon in which the vault of heaven appears to rest on an unbroken sea-like plain, as is so frequently the case in the Llanos, Pampas, and Prairies of America. I have, indeed, never observed anything approaching to this phenomenon, excepting, perhaps, where I have looked only towards one quarter of the heavens, for the Asiatic plains are frequently intersected by chains of hills, or clothed with coniferous woods. The Asiatic vegetation, too, in the most fruitful pasture lands, is by no means limited to the family of the Cyperaceæ, but is enriched by a great variety of herbaceous plants and shrubs. In the season of spring, small snowy white and red flowering Rosaceæ and Amygdaleæ (*Spirææ*, *Cratægus*, *Prunus spinosa*, *Amygdalus nana*.) present a pleasing appearance. I have elsewhere spoken of the tall and luxuriant Synanthereæ, (*Saussurea amara*, *S. salsa*,

Sea-like
plains.

Artemisia, and *Centaurea*.) and of leguminous plants, (species of the *Astragalus*, *Cytisus*, and *Caragana*.) Crown Imperials (*Fritillaria ruthenica* and *F. meleagroides*.) *Cypripediæ* and tulips gladden the eye with their varied and bright hues.

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“A contrast is presented to this charming vegetation of the Asiatic plains by the dreary Salt Steppes, especially by that portion of the Barabinski Steppe which lies at the base of the Altai Mountains, between Barnaul and the Serpent Mountain, and by the country to the east of the Caspian. Here the social *Chenopodiæ*, species of *Salsola*, *Atriplex*, *Salicorniæ*, and *Halimocnemis crassifolia*, cover the clayey soil with patches of verdure. Among the five hundred phanerogamic species which Claus and Göbel collected on the Steppes, *Synantheræ*, *Chenopodiæ*, and *Cruciferæ*, were more numerous than the grasses; the latter constituting only one-eleventh of the whole, and the two former one-seventh and one-ninth. In Germany, owing to the alternation of hills and plains, the *Glumacæ* (comprising the *Graminæ*, *Cyperacæ*, and *Junca-cæ*.) constitute one-seventh, the *Synantheræ* (*Compositæ*) one-eighth, and the *Cruciferæ* one-eighteenth of all the German Phanerogamic species. In the most northern part of the flat land of Siberia, the extreme limit of tree and shrub vegetation (*Coniferæ* and *Amentacæ*) is, according to Admiral Wrangell's fine map, 67° 15' north lat., in the districts contiguous to Behring's Straits, while more to the west, towards the banks of the Lena, it is 71°, which is the parallel of the North Cape of Lapland. The plains bordering on the Polar Sea are the domain of Cryptogamic plants. They are called Tundra (Tuntur in Finnish,) and are vast swampy districts, covered partly with a thick mantle of *Sphagnum palustre* and other Liverworts, and partly with a dry snowy-white carpet of *Cenomyce rangiferina* (Reindeer-moss,) *Stereocaulon paschale*, and other lichens. ‘These *Tundra*,’ says Admiral Wrangell, in his perilous expedition to the Islands of New Siberia, so rich in fossil wood, ‘accompanied me to

Barabinski
steppe.

Plants pecu-
liar to the
steppes.

Siberia.

Plains bor-
dering on the
Polar Sea.

CHAPTER
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regions.

the extremest Arctic coast. Their soil is composed of earth that has been frozen for thousands of years. In the dreary uniformity of the landscape, and surrounded by reindeer, the eye of the traveller rests with pleasure on the smallest patch of green turf that shows itself on a moist spot.'"

Returning from the consideration of this portion of the great general laws of the universe, so efficiently explored, Humboldt next passes to the detailed consideration of the great mountain systems of Central Asia, some of the phenomena observed in which have already been referred to.

Central
mountain
systems of
Asia.

The middle and internal part of Asia, which forms neither an immense aggregate of hills nor a continuous platform, is intersected from east to west by four great systems of mountains, which have exercised a decided influence upon the movements of nations. These systems are:—1. The Altaic, which is terminated to the west by the mountains of the Kirghiz; 2. Thian Chan; 3. Kwan-lun; and, 4. The Himalaya chain. Between the Altaic range and Thian Chan are Zungaria, and the basin of the Ele; between Thian Chan and Kwan-lun, Little or Upper Bucharia, or Cashgar, Yarkand, Khoten, or Yu-thian, the great desert, Toorfan, Khamil, and Tangout, or the Northern Tangout of the Chinese, which must not be confounded with Thibet or Sefan. Lastly between Kwan-lun and the Himalaya are Eastern and Western Thibet, in which are Lassa and Ladak. Were the three elevated plains situated between the Altai, Thian Chan, Kwan-lun, and the Himalaya, to be indicated by the position of three Alpine lakes, we might select for this purpose those of Balkachi, Lop, and Tengri, which correspond to the plains of Zungaria, Tangout, and Thibet.

Limits of the
Altaic range.

Altai system.

The mountain system of the Altai surrounds the sources of the Irtisch and Jenisei or Rem. To the east it takes the name of Tangnou; between the lakes Kosogol and Baikal, that of the Sayanian Mountains; be-

yond this it takes the name of Upper Kentai, and the Davourian Mountains; and, lastly, to the north-east it connects itself with the Jablonnoikhrebet chain, Khing-khan, and the Aldan Mountains, which advance along the Sea of Ochotzk. The mean latitude of its prolongation, from east to west, is between 50° and $51^{\circ} 30'$. The Altaic range, properly so called, scarcely occupies seven degrees of longitude; but the northern part of the mountains, surrounding the great mass of elevated land in the interior of Asia, and occupying the space comprised between 48° and 51° , is considered as belonging to this system, because simple names are more easily retained by the memory, and because that of Altai is more known to Europeans by its great metallic richness, which amounts annually to 45,907 troy pounds of silver, and 1246 troy pounds of gold.

CHAPTER
XXVIIILatitude of
prolongation.

A recent distinguished scientific reviewer furnishes this summary of the remarkable metalliferous treasures of the Altaic Mountains, much of which, however, it will be seen is already exhausted:—"The Altai, properly so called, namely, the Altai Kolyvan of Russian geographers, forms a mass of mountains which advances like a vast promontory to the western extremity of the chains which constitute the Altai system. Here were found the metallic eruptions, the working of which, between 1736 and 1745, excited such notice. These mines, however, no longer exist; but at the small town of Kolyva, we find the great establishment for the cutting and polishing of the pure granites, jaspers, and porphyries of the Altai. Near this establishment Nekita Demidoff erected, in 1725, his celebrated copper-works, which, from the want of fuel, and the necessity of enlarging them for the silver ores afterwards discovered, were transplanted to the confluence of the Barnaoulka and the Obi, where the city of Barnaoul forms the centre of these magnificent metallurgic establishments. The position of the rich mines of Schlagenberg, Zyriainovsk, Riddersk, and Kroukovsk, shows that the argen-

Metalliferous
treasures.Copper-
works.

CHAPTER
XXVIIIArea of the
Altai Koly-
van.Culminating
points.Direction of
strata.Elements of
direction.

tiferous region forms only the third part of the Altai, properly so called. The area of the Altai Kolyvan is about 4400 square leagues, nearly equal to that of England. The direction of its mean axis is from west to east, and, with the exception of its eastern side, it is surrounded by low regions,—a peculiarity the more remarkable, that, at a distance of twenty-five leagues, the Alps of Tigratzki and the Korgou rise rapidly to 7000 feet, and at the distance of fifty or sixty leagues, the Alps of Bieloukha rise to the height of 10,300 feet above the sea. The culminating points of this system lie in the second meridional range, a little to the east of the sources of the Ouimon, where, between the snowy Alps of Katunia and the Tchouya, the majestic peak of Bieloukha rises to the height of 10,300 feet. This inaccessible mountain has two horns entirely covered with snow, the westernmost being the highest. A glacier similar to those in Switzerland, and terminated by huge and ancient moraines, gives birth to the river Katunia. The two next highest summits are the *Alas-tou* and the *Irbis-tou*, thirty or forty leagues farther to the east. After stating that in the Altai the mean direction of the schistose strata is not, as in the Ural Mountains, parallel to the mean direction of the whole chain, our author discusses this curious subject with his usual perspicuity and learning, and points out the necessity of distinguishing, what have been so often confounded, the various elements of direction, *five* in number, which exist in every mountain chain. These elements are—

“ 1. The longitudinal axis of the entire chain, or of the upheaved mass.

“ 2. The line of ridge passing through its highest points.

“ 3. The line which follows the fissures of stratification.

“ 4. The watershed, or the line which divides the waters.

“ 5. The line which separates, in horizontal sections, two contiguous formations; for example, the granite

of the Silurian schists, the porphyries, and the red grits." CHAPTER XXVIII.

The Altaic Mountains are not a chain forming the boundary of a country like the Himalaya, which limit the elevated plain of Thibet, and have a rapid slope only on the side next to India, which is lower. The plains in the neighbourhood of the lake Balkachi have not an elevation of more than 1920 feet above the sea. Elevation of plains.

Between the meridians of Oust-Kamenogorsk and Semipolatinsk the Altaic system is prolonged, from east to west, under the parallels of 49 and 50 degrees by a chain of low mountains over an extent of 736 miles, as far as the steppe of the Kirghiz. This ridge has been elevated through a fissure which forms the line of separation of the streams of the Sara-sou and Irtisch, and which regularly follows the same direction over an extent of 16 degrees of longitude. It consists of stratified granites not intermixed with gneiss, and of greenstone, porphyry, jasper, and transition-limestone, in which there occur various metallic substances. Humboldt observes when referring to the granitic phenomena of this region :

—" In no part of the two hemispheres have I seen rocks which have more the character of eruption or effusion, than the granites which surround the mass of the Altai. These insulated rocks rise in the steppe at the foot of the Alpine Mountains, in the most picturesque forms. In descending from the steppe of Platovsk to the rocky banks of Lake Kolyvan, we are surprised by the granitic eruptions which, over several square leagues, rise from a perfectly smooth soil. The rocks are sometimes in a row, sometimes dispersed over the plains, affecting the most bizarre forms of narrow walls and little towers or polygons. The smallest masses resemble tribunes, chairs, or funereal monuments. But what gives so singular an aspect to this country, is the contrast in the height and volume of these granitic elevations. Some of them, such as the *Vysokaya Gora*, attain a height of 400 or 500 feet, while others are only seven or eight feet high, and Granitic phenomena.

CHAPTER
XXVIII.Forms of
granite
rocks.

remind us of the small volcanic elevations which cover the Malpays in South America. Other forms, more extraordinary still, distinguish the granite rocks on the southern declivity of the Altai. These have either the shape of bells or flattened hemispheres, or cones terminated often by lateral effusions, in the form of low and lengthened walls, as if they had flowed in a melted state from a crevice. I have been particularly struck with the form of a granite hill in the middle of a plain two versts from Boukhtarminsk. It resembles, on a large scale, the pyramid of Caius Cestius, near the Protestant burying-ground at Rome. At Oustkamenogorsk, we saw, rising towards the S.S.E., at the distance of eighty versts, in the middle of the steppe beyond the Irtyche, a mountain like a fortress flanked with small towers. It got the name of the mountain of the Convent from its having the form of a building in ruins."

Ural chain.

Jasper
porphyries.

This low range does not reach the southern extremity of the Ural, a chain which, like the Andes, presents a long wall running north and south, with metallic mines on its eastern slope, but terminates abruptly in the meridian of Sverinogovloskoi. One of these is called the Round Mountain, from its remarkable rounded form, and another the Ravennaja Sopka, or, Rhubarb Mountain. The latter is celebrated for its rich jasper porphyries. The imperial palaces of St. Petersburg are furnished with candelabra formed of this beautiful material nearly nine feet high; and a magnificent vase of the same precious material eight and a half feet in diameter, and four feet five inches deep. The block of jasper out of which this dish was cut weighed 28,000 pounds, and, in 1818, was transported in eight days, and by 400 workmen, across the roughest mountains, to the works at Kolyvansk. It required three years for cutting the block and polishing the vessel. Notwithstanding the moderate wages of the workmen, it cost the establishment 35,000 francs, without reckoning the expense of carriage to St. Petersburg, a distance of 700 leagues.

Here commences a remarkable region of lakes, comprising the group of Balek-koul (lat. $51^{\circ} 30'$), and that of Koumkoul (lat. $49^{\circ} 45'$), indicating an ancient communication of a mass of water with the Lake Ak-sakal, which receives the Tourgai and the Kamichloi Irghiz, as well as with the Lake Aral; and which would seem from Chinese accounts to have formed part of a great plain extending to the borders of the Frozen Sea.

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Lakes.

The mean latitude of the system of the Thian Chan chain is the 42d degree. Its highest summit is perhaps the mass of mountains covered with perpetual snow, and celebrated under the name of Bokhda-oola, from which Pallas gave the designation of Bogdo to the whole chain. From Bokhda-oola and Khatoun-bokhda, the Thian Chan, or Celestial Mountains, run eastward towards Barkoul, where they are suddenly lowered so as to fall to the level of the elevated desert, called the great Cobi or Shamo, which extends from Koua-tcheou, a Chinese town, to the sources of the Argoun. This forms, in reality, the great mountain chain of Central Asia. It extends almost uninterruptedly from east to west, between the latitudes of $40\frac{1}{2}^{\circ}$ and 43° , and is crossed by the meridional chain of Bolor, in east longitude 72° and latitude $40\frac{1}{2}^{\circ}$. These two mountain chains cross each other nearly at right angles, and mark the results of two great epochs of upheaval. They are, accordingly, characterized by very diverse mineral characteristics, into the consideration of which the scientific traveller has entered with great acuteness and considerable minuteness of detail. If we now return to Bokhda-oola, we find the western prolongation of these mountains stretching to Goudja and Koutche, then between Lake Temourtou and Aksou to the north of Cashgar, and running towards Samarcand. The country comprehended between the Altaic chain and the Thian Chan mountains is shut up to the east, beyond the meridian of Pe-king, by the Khingkhan-oola, a lofty ridge, which runs from south-west to north-east; but to the west it is entirely open.

System of
Thian Chan.Great moun-
tain chain of
Central Asia.

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Bolor.

Chinese
mountains.Western
prolongation
of the Thian
Chan.

The case is very different with the country limited by the second and third systems, the Thian Chan and Kwan-lun ranges; it being closed to the west by a transverse ridge, which runs north and south, under the name of Bolor or Beloot-taugh. This chain separates Little Bucharria from Great Bucharria, the country of Cashgar, Badakshan, and Upper Djihoun. Its southern part, which is connected with the Kwan-lun system, forms a part of the Tsungling of the Chinese. To the north it joins the chain which passes to the north-west of Cashgar. Between Khokand, Bervagel, and Hissar, consequently between the still unknown sources of the Sihon and Amou-deria, the Thian Chan rises before lowering again in the Kanat of Bochara, and presents a group of high mountains, several of which are covered with snow even in summer. More to the east it is less elevated. The road from Semipolatsinsk to Cashgar passes to the east of Lake Balkachi and to the west of Lake Issi-koul, and crosses the Narim, a tributary of the Sihon. At the distance of $69\frac{1}{2}$ miles from the Naim to the south it passes over the Rovat, which has a large cave, and is the highest point before arriving at the Chinese post to the south of the Aksou, the village of Artuche, and Cashgar. This city, which is built on the banks of the Ara-tumen, has 15,000 houses and 80,000 inhabitants, although it is smaller than Samarcand.

The western prolongation of the Thian Chan, or the Mouz-taugh, is deserving of a particular examination. At the point where the Bolor or Beloot-taugh joins the Mouz-taugh at right angles, the latter continues to run without interruption from east to west, under the name of Asferah-taugh, to the south of the Sihon, towards Kodjend and Ourat-eppeh in Ferganah. This chain of Asferah, which is covered with perpetual snow, separates the sources of the Sihon (Jaxartes) from those of the Amou (Oxus). It turns to the south-west nearly in the meridian of Kodjend, and in this direction is named, till it approaches Samarcand, Ak-taugh, or Al-

Botom. More to the west, on the fertile banks of the Kohik, commences the vast depression of ground comprising Great Bucharía and the country of Mavar-ul-Nahar; but beyond the Caspian Sea, nearly in the same latitude and in the same direction as the Thian Chan range, is seen the Caucasus with its porphyries and trachytes. It may therefore be considered as a continuation of the fissure upon which the Thian Chan is raised in the east, just as, to the west of the great mass of mountains of Azerbijan and Armenia, Mount Taurus is a continuation of the action of the fissure of the Himalaya and Hindoo-Coosh mountains.

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XXVIIIThe
Caucasus.

The Kwan-lun or Koul-koun chain is between Khoten, the mountains of Khoukhou-noor and Eastern Thibet, and the country named Katshi. It commences to the west at the Tsung-ling mountains. It is connected with the transverse chain of Bolor, as observed above, and, according to the Chinese books, forms its southern part. It crosses the Gobi between the meridians of Lake Gachoun, in longitude $86\frac{1}{2}$, and the eastern extremity of Bassadoungramoola, in longitude 92° . Humbolt remarks, that at a part of Gobi which forms the eastern border of the desert of Makhai there is in the prolongation of this mountain chain a manifest perturbation, caused either by the upheaval of the plateau, or, as is perhaps more probable, by the great mass of the snowy mountains of Khoukhou-noor. This corner of the globe, between Little Thibet and the Badakshan, is very little known, although it is rich in rubies, lapis lazuli, and mineral turquois, and in various localities works are established for the recovery of the mineral wealth with which the district abounds. Lieutenant John Wood, an enterprising English traveller, succeeded in surmounting the numerous obstacles which had impeded previous research, and in the spring of 1838, reached the source of the river Oxus. The natural phenomena with which he was there surrounded are very remarkable. At the immense elevation attained by him, he remarks: "We stood, to

Kwan-lun
chain.Mineral
riches.Source of the
Oxus.

CHAPTER
XXVIIILake Sir-i-
kol.

use a native expression, upon the *Bam-i-duniah* or *Roof* of the world, while before us lay stretched a noble but frozen sheet of water, (*Lake Sir-i-kol*,) from whose western end issued the infant river of the Oxus. This fine lake lies in the form of a crescent, about fourteen miles long from east to west, by an average breadth of one mile. On three sides it is bordered by swelling hills, about 500 feet high, while along its southern bank they rise into mountains 3500 feet above the lake, or 19,000 above the sea, and covered with perpetual snow, from which never-failing source the lake is supplied."

Elevated
source of the
Oxus.

Few more remarkable points of elevation could repay the toil of the enterprising traveller than this elevated source of the river Oxus. The Lake Sir-i-kol, from whence it flows, is situated some 15,600 feet above the level of the sea, and from the corresponding heights which surround it, some of the principal rivers of Asia take their rise. Lieutenant Wood has thus described one of the most important works in this district, by means of which some portion of its great mineral wealth is rendered available.

Ruby mines.

"The ruby mines are within twenty miles of Ishkashm, in a district called Gharan, which signifies caves or mines, and on the right bank of the river Oxus. They face the stream, and their entrance is said to be 1200 feet above its level. The formation of the mountain is either red sandstone or limestone, largely impregnated with magnesia. The mines are easily worked, the operation being more like digging a hole in sand than quarrying rocks. The galleries are described as being numerous, and running directly in from the river. Wherever a seam of whitish blotch is discovered, the miners set to work, and when a ruby is found, it is always encased in a round nodule of considerable size. The mines have not been worked since Badakhshan fell into the hands of the Kunduz chief, who, irritated, it is supposed, at the small profit they yielded, marched the inhabitants of the district, then numbering about 500 families, to Kunduz, and disposed of them in the slave market."

Mode of
mining.

According to the most recent accounts, the plain of Khorasan, which runs in the direction of Herat, and limits the Hindoo-kho to the north, appears to be rather a continuation of the Tsung-ling, or *the Mountains of Onions*, as this chain is somewhat quaintly distinguished, and of the whole system of Kwan-lun to the west, than a prolongation of the Himalayas as has been commonly supposed. From the Tsung-ling the Kwan-lun, or Koul-koun range, runs from west to east towards the sources of the Hoang-ho or Yellow River, and penetrates with its snowy summits into Shen-see, a province of China. Nearly in the meridian of these springs rises the great mass of mountains on the lake Khoukhounoor, resting to the north upon the snowy chain of the Nan-shan or Ki-leen-shan, which also runs from west to east. Between Nan-shan and Thian Chan, the heights of Tangout limit the margin of the upper desert of Cobi or Shamo, which is prolonged from south-west to north-east. The latitude of the central part of the Kwan-lung range is 35° 30'.

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The Tsung-ling.

Mountains
on the
Khoukhounoor.

The Himalaya system separates the valleys of Cashmere and Nepaul from Bootan and Thibet. To the west it rises in the mountain Javaher to an elevation of 25,746 feet, and to the east in Dhwalagiri to 27,737 feet above the level of the sea. Its general direction is from north-west to south-east, and thus it is not at all parallel to the Kwan-lun range, to which it approaches so near in the meridian of Attok and Jellalabad that they seem to form the same mass of mountains. Following the Himalaya range eastward, we find it bordering Assam on the north, containing the sources of the Brahmapoutra, passing through the northern part of Ava, and penetrating into Yun-nan, a province of China, to the west of Yong-tchang. It there exhibits pointed and snow-clad summits. It bends abruptly to the north-east, on the confines of Hou-quang, Kiang-see, and Fo-kien, and advances its snowy peaks towards the ocean; the island of Formosa, the mountains of which are in like manner

Himalaya system.

Eastern course.

CHAPTER
XXVIII.Continuous
chain of
mountains.

covered during the greater part of summer, being its termination. Thus we may follow the Himalaya system as a continuous chain from the Eastern Ocean, through Hindoo-kho, across Candahar and Khorasan, to beyond the Caspian Sea in Azerbaijan, along an extent of 73 degrees, or half the length of the Andes. The western extremity, which is volcanic (like the eastern part), loses its character of a chain in the mountains of Armenia, which are connected with Sangalou, Bingheul, and Kachmirdaugh, in the pashalic of Erzeroum. The mean direction of the system is north 55° west.

Elevation
of the
mountain
chains.

These mountain chains, with their various ramifications and intervening platforms and valleys, afford evidence to our author of revolutions anciently undergone by the crust of the globe; these having been elevated by matter thrust up in the line of enormous cracks and fissures. The great depression of Central Asia, spoken of above, he considers as having been caused by the same action. Analogous to the Caspian Sea and other cavities in this district, are the lakes formed in Europe at the foot of the Alps, and which also owe their origin to a sinking of the ground. It is chiefly in the extent of this depression of Central Asia, and consequently in the space where the resistance was least, that we find traces of volcanic actions.

Volcanic
action.

On this subject of volcanic action, and the upheaval and depression of vast areas, much new and very important light has recently been brought to bear from an entirely novel source. Turning from the phenomena of our own planet, philosophers have directed their improved telescopes to the moon, and by an intelligent analyses of the peculiar features which it exhibits have been able largely to add to our knowledge of the sources of many of the most remarkable physical characteristics of our own planet. At the meeting of the British Association, held at Edinburgh in 1850, Mr Nasmyth made a most interesting communication on the lunar surface. His attention, he said, had been directed for some time to

the remarkable appearances on the surface of the moon, in connexion with the light they seemed to throw on the study of geology, and he had procured some powerful telescopes in order to observe them more particularly, in addition to himself constructing one of great power, by the aid of which many of his most valuable observations have been made. He exhibited a variety of drawings which have been taken by himself from what he observed. The largest was a map, on a great scale, of the entire lunar surface, on which was strikingly depicted the peculiar nature of its surface, crowded with craterlike cups, in some places so close as to overlie each other, and as it were elbow each other out of the way. Other views included various portions of the surface which had been selected for more minute study. These representations have all been drawn from observations made in the most favourable circumstances, and with great care, the result of which is, that the conclusion is even stronger than in the case of the earth, that it was once wholly in a molten condition. The central cones seen in three-fourths of the lunar mountains show plainly that the formation observed is volcanic. These cones in the case of terrestrial volcanoes are the result of the expiring action of the volcano, after the eruptive energy has ceased to be able to project the molten mass over the sides of the crater, and the same thing has taken place in the moon. Many of its volcanoes are 60 or 70 miles across the crater—many times larger than those on the earth. But it is just because it is a very small body that it has very large volcanoes. The force of gravitation is much less at the moon, and hence the ejective force is able to expel greater masses, and to act more uninterruptedly. The crater of Etna is but a spot compared with some of those in the moon. The proportional size of these lunar craters may indeed be described as bearing in some degree an inverse ratio to the relative size of the earth and moon. The smallness of the moon, its mass being to that of the earth as 1 to 64, and its surface as 1 to 16, is also

CHAPTER
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of telescopes.Conclusions
established.Size of lunar
volcanoes.

CHAPTER
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of pheno-
mena.

the cause of the multitude as well as of the magnitude of these volcanoes. As the outer crust cooled, the moon would become, so to speak, hide-bound, and, by the contraction of the surface upon the liquid mass beneath, the latter would be spurted out in every direction, while the former would also exhibit those radiating striæ or cracks which are so very marked a feature in its appearance. Some of these cracks are upwards of 700 miles long. In illustration of the mode in which it is probable this appearance was produced in the moon, Mr. Naysmith showed portions of glass globes, which, after being filled with hot water, and then hermetically sealed, were broken by the application of cold to the outside. Besides the craters and these striæ, there are also many trachytic domes, where the force of ejection has not been sufficiently great to form craters; and lastly, there are great ranges of hills, the formation of which appears to have taken place in this way:—as contraction goes on, the liquid nucleus separates itself from the solid crust; the latter is bent inwards by the force of gravitation, and a cracking and crushing action takes place, with farther eruptions in mountain crests; or two adjacent surfaces are raised edge on edge as in fields of ice. A shrivelled apple may be referred to as affording a familiar illustration of this appearance and its cause.

Trachytic
dome.Ancient
volcanoes.

Several volcanoes are described by ancient Chinese writers, who also mention a variety of volcanic products, such as sal ammoniac and sulphur, which form articles of commerce. "We thus know," says Humboldt, "in the interior of Asia, a volcanic territory, the surface of which is upwards of 2500 square geographical miles, and which is from 1400 to 1800 miles distant from the sea. It fills the half of the longitudinal valley situated between the first and second system of mountains. The principal seat of volcanic action appears to be in the Thian Chan. Perhaps the colossal Bokhda-oola is a trachytic formation like Chimborazo." On both sides of the Thian Chan violent earthquakes occur. The city of

Aksou was entirely destroyed at the commencement of the eighteenth century by a commotion of this nature. In Eastern Siberia, the centre of the circle of shocks appears to be at Irkutzk, and in the deep basin of the Baikal lake, in the vicinity of which volcanic products are observed. But this point of the Altaic range is the extreme limit of these phenomena, no earthquakes having been experienced farther to the west, in the plains of Siberia, between the Altaic and Uralian ranges, or in any part of the latter.

CHAPTER
XXVIIIVolcanic
action in
Siberia.

It at once satisfies all the requirements of our reason and observation, to refer the origin of the great areas of upheaval or depression to the same operations as are now discoverable in an earlier stage of progress, and upon a large scale, in the attendant lunar satellite of our own planet. Thus does extended observation, and legitimate scientific induction, bring apparently the most diverse and unconnected phenomena to bear upon each other, and prove a remarkable and uninterrupted harmony to prevail throughout systems which, to the superficial observer, had seemed to possess no single feature in common.

Correspon-
dence of
terrestrial
and lunar
phenomena.

Viewed in the light of this new theory, many terrestrial phenomena will now be simplified and reduced to rule, which formerly were of difficult solution, if not apparently altogether lawless and incomprehensible; and thus, even the intelligent observations and comprehensive deductions of Humboldt are illuminated by a new light, of which he was unaware.

The volcanic territory of Bichbalik is situated to the east of this great depression of Asia, for which it is conceived the singularly interesting speculations of Mr. Nasmyth are so entirely fitted to account. To the south and west of the same internal basin we find two cones in activity,—Demawund, which is visible from Teheran, and Seiban of Ararat, which is covered with vitreous lavas. On both sides of the isthmus, between the Caspian and the Black Sea, springs of naphtha and mud-eruptions are numerous.

Volcanic
territory of
Bichbalik.

CHAPTER
XXVIIISouthern
Russia and
Poland.

Pursuing our investigations of the great features of the Asiatic continent where it passes into that of Europe, if we proceed from the Caucasian isthmus to the north and north-west, we arrive at the territory of the great horizontal and tertiary deposits of Southern Russia and Poland. These are situated on the western margin of the great Asiatic area of depression. Here we find igneous rocks piercing the red sandstone of Jekaterinoslav, together with asphaltum, and springs impregnated with sulphurous gases.

Central
depression of
Asia.

A phenomenon so great as that of the central depression of Asia, which resembles the circular valleys of the moon, could have been produced only by such a very powerful cause acting in the interior of the earth, as has been assumed to account for the corresponding features visible on the moon's surface. This cause, while forming the crust of the globe by sudden raisings and sinkings, probably filled with metallic substances the fissures of the Uralian and Altaic chains, injecting into them, from the liquid central regions, these rich veins of ores, and mineral treasures, which now repay the labours of the miner; while they supply to the philosopher peculiar elements by which to classify the various ranges of upheaval, and even to assign a relative chronology to the several mountain chains that range across the continent of Asia, and are continued to the west of Europe.

Ural moun-
tain system.

The great chain of the Ural mountains does not properly belong to the mountain systems of Central Asia, being itself the boundary line which separates the continents of Asia and Europe, and having thus an Asiatic and a European slope, the mineral and geological characteristics of which differ in many important points. This subject has been illustrated at great length, by Sir Roderick Impey Murchison, aided by M. De Verneuil and Count Alexander Von Keyserling, in their valuable work on the geology of Russia in Europe, and the Ural mountains. In this work, considerable advance is made on the previous observations of Humboldt. The great

meridional chain of the Ural mountains extends over 18° of latitude, from the Arctic Ocean on the north, according to Humboldt, to the higher grounds between the Aral and the Caspian Sea. The Ural mountains are composed of crystalline and slaty rocks, abounding in minerals and metallic ores. Numerous outbursts of eruptive rocks have broken up, and overflowed the earlier strata, rendering their exact separation and orderly classification extremely difficult. In the remarkable series of geological changes which have produced these results, all the richest metalliferous ores have been produced on the Asiatic flank, where they are found in veins, masses, or irregular deposits. This region accordingly supplied, for a considerable period, one of the chief sources of economic mineral wealth, and is still wrought for this purpose with considerable success.

Minerals and
ores.

In accounting for some of the remarkable geological phenomena discoverable in the Ural mountains, the authors of the *Geology of Russia and the Ural Mountains* remark:—"The low region of Siberia, into which these folds or corrugations pass, is to a great extent occupied by granitic rocks. With very limited exceptions, true granites seem never to enter into the higher portions of the Ural, the culminating points of which generally consist of altered palæozoic strata, usually in the state of quartzose and chloritic rocks, sometimes as mica schists, with saccharoid marble, whilst promontories of greenstone, porphyry, and syenite, indenting and breaking in, as it were, upon the central and sub-crystalline ridge, often constitute the highest peaks.

Geological
phenomena.Character-
istic rocks.

"Notwithstanding, however, the striking contrast which is presented by the opposite sides of the Ural chain, we convinced ourselves that, in the early periods, there had taken place, all over this region, and probably extending far into Siberia, a deposition of Silurian, Devonian, and Carboniferous strata, which, by the linear outbursts of granitic rocks on some lines, and of porphyries and greenstones on others, in lines from N. to E., was thrown up

Successive
changes.

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into, and formed, this chain anterior to the accumulation of the Permian deposits. As the latter have not been observed on its eastern flank, we may be permitted to surmise, that in those early periods a large portion of Siberia adjacent to the Ural was also raised from beneath the sea, and put without the reach of these waters, under which the upper sands and their associated marine animals were accumulated."

Intruded
igneous
rocks.

The geological phenomena of the great Ural system are of the most remarkable description. The strata appear, in some cases, highly metamorphosed by the subsequent action of heat; in other cases, they are dislocated and intermingled with intrusive igneous rocks, broken up, and thrown about in the most irregular manner, and even in some remarkable cases, completely inverted. It is obvious, indeed, that no single theory will suffice to account for all the geological changes discoverable by the careful scientific observer in these extensive mountain systems. Some of the phenomena are the result of a slow, continuous element of change, operating over a very long period of time; while others can only be ascribed to some vast and terrible natural convulsion, in which the internal fountains of molten material have forced their way through the consolidated crust of the earth, breaking up and dislocating its strata, crushing it together like ice flows, into the mountain ranges which remain extended through many degrees, and injecting and overflowing the whole with igneous and metalliferous formations. It is during some of the latest changes of geological periods that the valuable metalliferous deposits are supposed to have been formed. "That the Uralian chain," the authors of the Geology of the Ural Mountains remark, "became auriferous during the most recent disturbances by which it was affected, and that this took place when its highest peaks were thrown up, when its present water-shed was established, and when the syenitic granites, and other comparatively recent igneous rocks were erupted along its western slopes.

Various
sources of
change.

Formation of
metalliferous
deposits.

“The only detritus in which grains and portions of gold and platinum have been found, is, in truth, that in which remains of mammoths and rhinoceroses have also been detected; and coupling this last fact with the omission of all auriferous veins in the more ancient alluvia of the chain, there can be no doubt that in this region gold was one of the most recent mineral productions anterior to the historic era. The very nature and form of the ground in which the auriferous debris have been heaped up, shows, that unlike the ancient or Permian detritus, this took up its position when the present configuration had, to a great extent, been brought about, and when valleys existed, in which large quadrupeds, closely allied to those which now live among us, were entombed. We believe, then, that before the surface assumed its present outline, the tract we now call the Ural mountains was a low ridge, extending from north to south, and forming the western shore of a continent on which such animals lived and died during long ages.”

CHAPTER
XXVIII.Auriferous
veins.

Into the very interesting inquiries relating to the habitat of the mammoth, and the valuable discussions by which men of science have sought to clear up the mystery pertaining to this extinct species, it is not necessary to enter at any very great length. In 1829, the valuable gold mines of Peshanka, near Bogoslofsk, were discovered, and have since been wrought with great success. In the same auriferous district, the bones of the mammoth, the rhinoceros, and *boss urus*, have been found in great abundance in the clay which overlies the gravel, and also in the gold detritus. Cuvier, and other distinguished men of science, who have investigated this subject, have advocated the opinion that the mammoth was the native of a warm climate, and became extinct by some sudden change, which entirely altered the temperature of the regions of their habitat, preserving them thereby, in some cases embedded in masses of ice, in a perfect and entire state. This idea is now, however,

Mammoth.

Ossiferous
deposits.

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collateral
points.Indications
of mountain
chains.Interest
of physical
geography.

very generally abandoned ; and the careful investigations, both of zoologists and geologists, leaves little room to doubt that the gigantic mammoth was a native of the frozen north, along with the rein-deer and other inhabitants of the arctic regions.

Numerous important collateral points, relating to the upheaval of land, volcanic action, marine influences, gaseous and boiling springs, mud volcanoes, and other remarkable natural phenomena, are brought under review by the great traveller, in the course of his valuable labours. The subject is not one calculated for popular readers, nor is it treated as such. Nevertheless, like all researches into the mysterious laws of the universe, it abounds in disclosures which cannot fail to attract the inquiring mind. The great mountain chains which have heretofore been regarded chiefly as the boundaries of kingdoms, or the natural demarcations of continents, are reviewed by Humboldt as the indices of those great changes by which the earth has been adapted for its present purposes, and made meet for the habitation of man. It is thus that the grasp of a profound intellect traces back the operations of nature to their source, and reveals to us the method by which the Creator works out his plans. By such means the study of physical geography has acquired an interest equal to that which the wondrous revelations of the astronomer, and the profound speculations of the geologist, had already thrown over these kindred sciences ; and now that we are learning to apply the remarkable phenomena discernible in the moon's illuminated phase, to instruct us in deciphering the mysterious records of our own planet, we may anticipate fresh insight into the causes of the physical characteristics by which our earth is heaved up into such vast mountain chains, and spread out between into green valleys or vast plains, adapted for every stage of being, and wonderfully suited to supply the wants, and minister to the necessities of man.

It is no new idea to seek, in the attendant satellite of our earth, for illustrations and elucidations of terrestrial phenomena. It has long been the opinion of scientific men, that the moon is, to a great extent, passing through a stage of its being, corresponding to one which marked the prior existence of the planet on which it waits, and to the intelligent occupants of which it ministers so many important benefits. Mr. Nasmyth, in the graphic elucidation of his views, characterized it as the great health-preserver, and scavenger, which maintained the waters of our planet in constant motion, and thus rescued us from the pestilence and horrors which must ensue, were the great highway of the nations to become a universally putrid and stagnant sea. Again, he compared it to a mighty fixed engine, working with systematic precision in all our estuaries and rivers, and dragging our merchant navies up and down the great water thoroughfares of domestic traffic. Since ever the universal dominion of the law of gravitation came to be fully recognised, a growing conviction has been present in the minds of the students of science, that a perfect harmony prevails throughout the whole created universe. This idea has, indeed, been recently carried to an extravagant and foolish length. Men of shallow and superficial views, intent on carrying out this discovery to what they assumed must be its legitimate conclusions, have advanced theories equally derogatory to the Creator and his works. Mistaking uniformity for harmony, they have assumed that our little planet is but a type in miniature of the whole creation, and that God, in multiplying worlds amid the immensities of space, has only been repeating the one idea of which we are cognizant. Such a misconception of the powers of the Infinite happily does not stand in need of any elaborate argument to confute it, for every new disclosure, alike of the telescope and the microscope, reveals the boundless diversity which prevails amid the

CHAPTER
XXVIII.General
opinions
on lunar
phenomena.Practical
uses of
the moon.Superficial
theories.

CHAPTER
XXVIII.General
operation
of known
laws.

Gravitation.

Its univer-
sality.

harmony of the works of the Creator. Along with this diversity, however, it is unquestionable that many other laws besides that of gravitation operate beyond the limits of our own sphere ; and in pursuing our investigations into these, not only our own neighbouring satellite, but the solar system, and even the fixed stars and remoter nebular groups, are being laid under contribution for evidence in proof of the same indications of harmonious order and benevolent design, with which we are familiar on the surface of our own planet. On this subject, Professor Nichol has remarked :—" I have spoken concerning the probable existence of life through all these spheres. Let us look for one moment, before concluding the subject, at the real nature of the question, which is of all the most interesting. It appears equivalent to this : Are we, without passing into extravagance, entitled to assume that forces, which in so far as we have positively traced them, enter as essentials into the constitution of our earth, are not confined within its conditions ? Think of gravity. Before science raised the veil from the distant, we knew it only in the fact of the fall of a stone, or in the roundness of a drop of water ; now, we have followed it through the complex motions of the moon, and through the order of the entire system. It pursues the comets through the abysses ; it governs the orbits of the double and triple stars ; it guides the sun in his path through the skies, ay, and even those stupendous evolutions of firmaments, during which the stars congregate into dazzling clusters, or arrange themselves in gallaxies. Boundless the sphere of this force ; and shall an energy yet nobler, more subtle, probably with a root much more profound, be fancied so weak, so feeble, so dependent on circumstance, that only in our world, or some one like it, it is free to work out its wonderful products ? Look at its history in that very earth. In the chalk cliffs, in caverns unseen by the sun, in marshes that to man are desolation and death, life yet teems and rejoices—its forms growing in

adaptation to their conditions. Long ages ago the odd trilobite swarmed in our oceans, and the large-eyed ichthyosaur dashed through their waters. These are all gone ; but plastic nature, ever forming with ceaseless activity, has, by the most mysterious of her actions, brought up new forms to play their parts among her vast scenes. Through space, as through time, she is doubtless working ; and with all their joys and sorrows, evolving far mightier results than the formation of inorganic worlds. I see this in the blush of the morning which beams on all these globes, and there, too, awakens the glad creatures from their repose. I see it in the downfal of evening, that speaks of refreshment from toil, but also of the living-time of activities not fitted for the sun. I see it in the progress of the earth, and in its course, through much conflict, towards perfection : for its rocks and stones tell not only of change, but of the struggles of its creatures to become linked to something higher :—Yes ! ye worlds, wondrous and innumerable, that shine aloft, and shower around us your many mystic influences,—ye, too, are the abodes of sentience suited to your conditions, ay, and of intelligence, different, far different from ours, and in states of approach to the Divinity of all possible gradations ; but of which every constituent, where every creature, of whatever kind, is pressing outward like the bud in spring, and stretching, with longings that are unutterable, towards the Infinite and the Eternal !”

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Progress
of organic
life.

Evidence
of continual
operations.

Not the least gratifying idea which these reflections suggest, is the endless progression in knowledge, and the clearer understanding of the works of creation, which the mind of man is seen to be capable of. The past and the future, the near and the remote, all lie within its grasp ; and while the infinite works of the Creator can never be exhausted by his creature, it is a delightful thought to the intelligent mind, that amid all the ages of that future to which the hopes of the Christian extend, his mind shall be ever expanding amid new

Capacity of
the human
mind.

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Greatness
and power of
the Creator.

and fuller disclosures of the wisdom, the power, the goodness, and the infinite greatness, of Him who removeth the mountains and they know not; who overturneth them in his anger: who shaketh the earth out of her place, and the pillars thereof tremble; who commandeth the sun, and it riseth not, and sealeth up the stars; who alone spreadeth out the heavens, and treadeth upon the waves of the sea; who maketh Arcturus, Orion, and Pleiades, and the chambers of the south. . . . Hell is naked before him, and destruction hath no covering. He stretcheth out the north over the void, and hangeth the earth upon nothing. He bindeth up the waters in his thick clouds; and the cloud is not rent under them. He holdeth back the face of his throne, and spreadeth his cloud upon it. He hath compassed the waters with bounds, until the day and the night come to an end. The pillars of heaven tremble, and are astonished at his reproof. He divideth the sea with his power, and by his understanding he smiteth through the proud. By his spirit he hath garnished the heavens; *lo, these are part of his ways; but how little a portion is heard of him? The thunder of his power who can understand?* Such were the reflections of the ancient patriarch of Uz, while yet the discoveries and the appliances of science were all unknown, and yet they come to us now with even more power when armed with all the revelations of modern science, and instructed by the profound reflections of an observer like Humboldt, who brings all the most valuable discoveries, and all the disclosures of his own extensive experience, to aid in elucidating the phenomena with which we are surrounded.

Limits of
our know-
ledge.

The same interesting popular author, whose general reflection on the harmony of the universe have already been referred to, thus remarks on that most interesting, though extremely limited point of our own system, to which attention has been so vividly attracted by recent illustrations, drawn from it in elucidation of terrestrial phenomena:—"It is scarcely possible," observes Profes-

sor Nichol, "to conceive a more remarkable contrast than that between the appearance of the moon to the naked eye, and that which she presents to the telescope, whether in quadrature, or when she is full. Instead of a plain and bright surface, sending from all its parts an illumination not far from equable, we discern a body of most strange character, broken by irregularities which, in extent and form, present few analogies with the mountainous regions of our own globe. The reality of these, as well as the singularity of their contours, the briefest glance at the crescent luminary is sufficient to establish. The incomplete edge is, in that case, under the influence of a morning or evening light; and all the phenomena of lightened peaks, dark valleys, and long shadows, which occur in a broken district of the earth in such circumstances, are there distinctly visible, but on a scale far more grand. Look, for example, at a scene near Tycho, where the sun is shining obliquely on the rims of tremendous pits, or circular caverns, some of which are as deep as Mont Blanc is high,—and say, if that beauteous luminary, notwithstanding her placid smile, has not, even as our own shattered globe, undergone a troublous history! The representations given, so far from being exaggerated, are but feeble approximations to the reality; nor can the moon in any phase be painted. The living glory of the real object cannot be transferred to the canvass—no shade or colouring can accomplish that; but the features which are concerned with our scientific inquiries may all be exactly preserved.

"It will be seen," the author then remarks, in referring to his illustrations of the appearance of the satellite, "that a complete survey of the moon's surface is quite within our reach. No elevation of any magnitude, when on the *EDGE*, can fail to cast a long shadow,—the rays of the rising or setting sun then falling on it very *obliquely*; and not only does this shadow reveal the *existence* of the elevation, but its length, which can be accurately measured, must evidently indicate the *height* of the moun-

CHAPTER
XXVIIIMountainous
regions.Indications
of convul-
sions.Adequate
means of
observation.

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Measurement by shadows.

tain or ridge. We know that the shadows of the objects around us are longer or shorter just as the sun has attained to a lesser or greater height above the horizon ; and as the relations of that orb to the moon are perfectly understood, it is easily discovered what his elevation is above the horizon of any body casting a shadow there ; so that the shadow is an accurate indication of both the form and the magnitude of the mountain from which it is thrown. It is the same with those remarkable caverns. Suppose a deep hole in a table, and let a candle approach it,—the deeper the pit, the nearer must the candle be before the light reach its bottom ; and exactly thus must the position of the sun, when the profundities of these lunar pits are pierced through, enable us to judge how far they descend into the body of that globe. Acting on these simple principles, and therefore watching the crescent edge through many lunations, several celebrated astronomers have constructed maps of our satellite. Without referring to the older labourers, who wrought under the disadvantage of imperfect telescopes, I must distinguish Schroeter, whose enthusiasm in this field was worthy its dazzling object. But it is to Maedler, now of Dorpat, that we owe the first accurate selenotopography. This excellent and industrious observer has, in conjunction with M. Baer of Berlin, drawn a map of the moon's surface, of three feet in diameter ; of which, I believe, this at least may be said,—it is more accurate than any existing chart of either hemisphere of our own globe."

Lunar pits.

Schroeter and Maedler.

Lunar maps.

It may seem, at first sight, altogether extravagant to speak of more perfect maps existing of the moon than of the earth ; but a very little reflection will show that, while the delineator of the surface of the moon literally draws that which he sees, it is only by a complicated and laborious system of triangulation and measurement, that charts and maps can be constructed, even of a very small portion of the earth's surface. Professor Nichol thus sums up the observations of various observers in

relation to the mountain systems and intervening areas of the moon:—and these are of the more interest to the reader, as putting him in possession of evidence in relation to the similarity observable between terrestrial and lunar phenomena, published considerably prior to the recent demonstrations of Mr. Naysmith, which have been alluded to above. “Taking,” the Professor remarks, “the lunar mountain formations in the order of their simplicity, we discern, at the outset, a great number of perfectly isolated peaks, or sugar-loaf mountains, *unconnected with any group or range whatsoever*. In our own globe, such peaks are not uncommon, as in Cantal, for instance, or Teneriffe; but those generally belong to some large sphere of disturbance, and the nature of the forces and operation that produced them can, however dimly, still with some degree of certainty be conceived. These singular formations in the moon, however, very often present no analogy, in this respect, with the corresponding phenomena of our planet. They rise suddenly from the midst of unbroken flats, and at a great distance from general disturbances. They seem to have shot through the plain, in obedience to some sharp internal force, as one would push a needle through a sheet of paper; and the plain has not been much more disturbed. Perhaps the finest instance of this is Pico, a very brilliant rock, about half as high as the loftiest of our Alps, which towers almost precipitously north of Plato. No system whatever is connected with that remarkable peak; it is there a solitary, unaccompanied protrusion. Strange, indeed, the internal energies resulting in such phenomena! We are accustomed to consider apparently isolated outbursts on the earth, as isolated only in appearance—as the fragments—the remnants of some large and continuous system, whose parts have been abraded and washed away; but in the moon there are none of those meteorological agencies that have broken and changed the contour of our mountains. As we proceed, however, greater apparent breaches of analogy will press

CHAPTER
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ranges.

for notice ; although, if I mistake not, by their very contrast with what surrounds us, these will, in some instances, throw light on problems regarding the structure of our globe, which have hitherto baffled inquirers.

“ Mountain ranges, or chains, are by no means wanting in the moon, although a glance at the map will show that they are not a chief feature among the elevations of that body. Their general position is a sort of circular but broken skirt of the greater flats or plains. For instance, the Apennines, the Caucasus, and the Alps, forming, in fragments of a ring, one edge of the *Mare Imbrium*. Some of these reach a great elevation ; the Apennines rising from eighteen to twenty thousand feet—much higher than Mont Blanc ; and there is another ridge, on the very rim of the moon, which appears rival the gigantic Andes or Himalaya. There are two sets of phenomena connected with these lunar ranges bearing so closely on some theories regarding similar terrestrial forms, that I am induced to specify them.

Forms of
mountain
ridges.

“ We find here, as on the earth, that the ridge is uniformly extremely steep on one side,—descending to the plain through abrupt precipices, or a succession of abrupt terraces, while they slope away, as ours do also, on the other side, through an extensive and gently declining highland. The Lunar Apennines and the Asiatic Himalaya are illustrations of this singular fact, of about equal force. But the moon unfolds something more : the abrupt face of the mountain chain is uniformly toward the plain. This is very distinct in the case of the *Mare Imbrium* ; and we find the same with regard to every other plain, such as the *Mare Serenitatis*. Turn now to the earth. Suppose the vast Pacific drained of its waters, and that the Indian and Southern Oceans had become dry land ; that would be a mighty flat or lowland, broken only as the lunar plains are broken—here and there by a ridge—a crater, and group of mountains—but observe its edge ! Skirted on one side by the precipitous faces of the Andes and Rocky Mountains ; and

Mare
Imbrium.

the other, after some breaks, by the still more precipitous Himalaya and the Paropamisan, and then by the fronts of the heights of Abyssinia and Lupata,—in all of which the slope is on the *opposite side*, forming, in the two chief instances, the continent of South America and the long inclination of Siberia. This is not a mere *analogy* but an *identity* of phenomena. And their solution must, in both orbs, be connected with the formation of the plains which these precipices engirdle. It has yet to be found: but our terrestrial geographer may, in the meantime, safely dismiss speculations concerning floods and vast currents as being the cause of the contrast of these opposite contours, seeing that he must comprehend the moon also, where there is no water, and never has been!

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XXVIII.
Identity of
phenomena.

“It will be granted, that when a terrestrial phenomenon is sought to be referred to some cosmical agency, that is, to an agency not dependent on any *peculiarity* of the earth, but inherent in its nature as a *planet*, it is wholly legitimate to test the truth of the theory by applying it to the constitution of other orbs. Now, until very lately, it was scarcely possible to scan a few pages of a geological work without encountering cosmical theories regarding the elevation of our mountain chains. I shall refer to only one. The ingenious and learned De Beaumont proposed, not many years ago, what he termed the theory of secular refrigeration. It was in substance this:—The earth is still cooling; in the process of cooling the outer crust contracts; and, in the course of ages, it will press so violently on the molten mass within, that, through the resistance of that mass, it must *crack*; and the fragments will, by the protrusion of the internal fluid, be pressed upwards, and form mighty ranges of mountains. It followed, from this theory, that all the ranges would, in the main, lie along great circles of the sphere; and De Beaumont superadded the assertion, that there would be other *parallel* cracks at the same time; so that all parallel ridges of mountains might safely be

Test of terrestrial phenomena.

Theory of De Beaumont.

CHAPTER
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former
observers.Experiment-
tal results.

assumed to be of the same age, or to belong to the same epoch. How utterly the whole fair speculation vanishes before one glance into the universe farther than our door-steps! If the earth was cracked in this wise must the moon have been; but in the moon there is one instance of a chain lying along a great circle of a sphere, or having connection with aught save the great plains; and there are no parallel ridges at all!"

From these observations, the reader will see that astronomers have long been familiar with the illustrations derivable from lunar phenomena, of the successive changes through which our own planet has passed. We will observe, moreover, that the speculations already referred to are only the revival of ideas previously advanced though now rendered more consistent, and confirmed by much additional evidence, derived both from telescopic observation, and from analytic experiments. We find, however, in the remarks of Professor Nichol, in reference to the theory of De Beaumont, that the idea of compression and upheaval being the result of the irregular contraction of the whole earth's crust has not hitherto been received without dispute, nor is it likely that it will now be accepted implicitly. It is not, however, to be received in its latest form as a mere theory, but rather as the result of conclusions forced on the mind of an intelligent and practical observer by the various phenomena brought under his notice by the telescope, and confirmed by the analogies which his crucial experiments elicited. Professor Nichol attaches importance to the absence of a general parallelism in the striae on the moon's surface, as an evidence of the fallacy of De Beaumont's theory, and in this he was so far justified, for that ingenious theorist having assumed that such would be the necessary result of the force which he sought to account for. The experiments of Mr. Nasmyth, however, already referred to, show an entirely different result, completely corresponding with the radiating striae with which we are actually familiar on the surface

the moon. We are therefore confirmed in the value to be attached to illustrations and elucidations of terrestrial phenomena, derived from those which are discoverable in its attendant satellite ; and though some of those most recently advanced may be open to dispute, we cannot doubt that further observation will lead to still greater revelations of truth, in relation to those astonishing revolutions on our own planet's surface, which supervened while yet "the earth was without form, and void, and darkness moved on the face of the deep."

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Value of
such refer-
ences.

The third and concluding volume of Humboldt's "Researches in Central Asia," enters into questions no less interesting to the natural philosopher than those which precede it ; though it is not easy to reduce to an abridged and popular form the original views, and numerous new and important facts and observations, which are embodied in it. It includes "Considerations on the Temperature and Hygrometrical state of the Air, chiefly in Asiatic Russia;" "Researches on the Causes of the Inflection of the Isothermal Lines;" "On the Magnetic Inclination observed in Russia in 1829, and on the Peculiar Phenomena observed in the Climate of that country." It also includes a section on the "Routes in Central Asia." All of these embody many valuable and important observations, and those which specially refer to climate and the distribution of heat, embody an amount of original views and observed facts, such as no other individual has ever brought to bear on these important subjects. To these observations, indeed, we owe the establishment of many of the most important recognized meteorological laws, as well as the establishment of an isothermal system applicable to the whole globe, and resting mainly, not on theory, but on well-ascertained data. The result of these may be thus briefly reduced to an abstract. The isothermal lines, or the lines of equal annual mean temperature over the globe, vary very considerably from the parallels of latitude, and deviate with much irregularity in different countries, so

Philosophic
researches.

Meteorologi-
cal laws.

CHAPTER
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lines.

that the popularly accepted zone's comparative heat and the supposed equatorial line of highest temperature can hardly be accepted even as a rude approximation to the general law by which the regions of perpetual snow are fixed at the poles, and those of unendurable heat at the equator. An entirely new system of physical geography is rendered necessary, in order to make this rational system of ascertained truths practically available, and this has already been accomplished with great learning and practical skill, by Mr. Alexander Keith Johnston of Edinburgh. As a practical synopsis, not only of this department of physical science, but of all the sub-divisions of geography and ethnology, Mr. Johnston's "Physical Atlas" is the most valuable and comprehensive work to which the scientific student can refer.

Line of
maximum
temperature.

Theoretical
and ascer-
tained lines
of tempera-
ture.

Comparing ascertained facts relative to the meteorological condition of various extensive regions, it is found that the probable line of maximum temperature of the atmosphere, or the atmospheric *thermal equator*, as it may be styled, differs very considerably from the equator of the earth. In the northern hemisphere it intersects 25° degrees of its circumference, while in the southern hemisphere it only intersects 105 degrees,—an amount of difference which shows that there is hardly an approximation of the true thermal equator to the geographical line with which it was long held to coincide. We perceive, accordingly, from this, how limited an influence the mere relative position of certain portions of the earth to the sun, exercise upon their actual or annual mean temperature. Were the earth, indeed, a plain solid sphere, of equal level, and perfect homogeneity throughout, the old theory of frigid, temperate, and torrid zones, would hold true in fact; but in so far as it in reality differs from this, does the theoretic geographical division fall short of the truth in relation to the actual ascertained scientific lines of temperature. The previous observations on the peculiar geographical and geological features of the Asiatic continent will have prepared the reader

for appreciating the nature of the evidence by which such results are established. Elevated plateaus, mountain ranges rising within the region of perpetual snow, vicinity to, or distance from the ocean, insular or inland position, extensive natural irrigation, geological peculiarities of soil and stratification, and the peculiar development of vegetable life, all more or less influence the temperature of regions, establishing temperate climes alike within the torrid and the frigid zones, and filling the ample beds of the Nile and the Euphrates, from the snows that melt within the range of the equatorial sun. It is now well known that the magnetic pole does not coincide with the true geographical pole. The results of Humboldt's isothermal system, as deduced from his own personal investigation, has led to extended observations by others, which also promise to be productive of the most important results. One of these aims at establishing the actual position of the cold poles, or the precise points in the northern and southern hemispheres, where the mean temperature is lower than at any other part of the globe. Already an approximation to this has been made, and though it is still unsafe to attempt to deduce any absolute or precise conclusions from this, it is remarkable that the eastern and western poles of lowest mean temperature, appear very nearly to coincide with the magnetic poles of the earth. This remarkable result is well calculated to excite the liveliest interest in men of science, and to urge them to renewed zeal. It may, indeed, prove that the connection of the cold and magnetic poles is merely accidental, but meanwhile it seems more probable that it points to some important, and hitherto unknown law, which shall yet reveal the full nature and extent of operation of that mysterious power which is known as magnetism.

A glance at the map of the two hemispheres, accompanied with some knowledge of the ascertained isothermal data, is sufficient to show how great are the variations of mean temperature that may be looked for. The geogra-

CHAPTER
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variation.Position of
poles of
lowest
temperature.Variations
of mean
temperature.

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regions.Isothermal
zones.Inflexions of
Isothermal
lines.

physical equatorial line passes through the continents of Africa and South America, leaving nearly a third of the former, and fully five-sixths of the latter to the south of the equator, while no portion of the entire Asiatic continent extends so far south as to the equator. The equatorial regions of Africa and South America are accordingly exposed to the direct rays of the sun, influenced only by such modifications as the physical conformations of either continent may effect, while the same region, lying in the Indian seas, is tempered by the meliorating and more equable temperature of the ocean, so that the vast regions of Australia which lie within the same parallels of latitude as the southern part of the African continent, are now supplying to the British emigrant a temperate climate, more constant, but little more oppressive than the mild summers of the British islands. The isothermal zones, which are thus made to take the place for certain purposes, of the older geographical divisions of the globe, must be ascertained by observations entirely different from those of the mathematician and the astronomer. The thermometer is the chief instrument of the isothermal observer, and by means of it the globe has been divided into zones of equal annual mean temperature, the perfect knowledge of which involves many important practical results. The inflexions of these isothermal lines is often very remarkable. On the South American continent, for example, the equator of temperature deviates entirely from the geographical equator, being inflected entirely to the north, and exceeding, by a mean temperature of ten degrees, the true geographical equator. In Africa also it lies to the north of the geographical equator, though the isothermal inflexion is not to the same extent; while in Asia the two equatorial lines almost exactly coincide, the island of Borneo, and the Indian seas, lying directly on the line of the geographical equator, and within the zone of highest temperature. The deviations and inflections of the isothermal zones are much less marked where they occur within a large

area of ocean, the sea presenting a medium readily and equally heated, and less susceptible of local influences on its temperature than the land. Even then, however, currents exercise a considerable influence, and occasional very marked inflexions of the isothermal zones occur within the area of the ocean.

CHAPTER
XXVIIITemperature
of the ocean.

But in addition to the results which these observations involve as to the variations in the distribution of heat over the earth's surface, they also lead to the consideration of another remarkable class of phenomena connected with the unequal distribution of heat over the year. In the cold meridians, as is well known, a brief, but very hot summer, and a cold winter occur, whereas in southern latitudes of Europe and America, the cold of winter is greatly moderated, and in the whole warmer meridians of the globe, the difference between the temperature of summer and winter is greatly diminished. The full importance of these observations of isothermal phenomena is now fully appreciated; but it is only by a very extensive and combined series of observations that these comprehensive bearings will be made fully known, and the direct clue obtained to the great laws which they involve. The meteorological observations which are now established in so many parts of the world are accumulating much valuable data for this purpose. Private observers may also do much, and have already furnished some important contributions to the same end, so that the great scientific traveller to whom we owe the foundation of these remarkable disclosures regarding the laws that govern the universe, has the satisfaction or himself observing a noble host of scientific pioneers advancing on the path which he had pointed out, and following up his suggestive thoughts by the patient and laborious analysis of scientific investigation.

Periodicity
of tempera-
ture.Importance
of isothermal
observations.

But Humboldt has also taken into consideration other sources of heat besides that which the earth derives from the sun. He even reasons on the possibility of the earth being a mere solid shell, inclosing a fluid mass, the heat

Other sources
of heat.

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XXVIII.Internal
source of
heat.

and motion of which may alike affect the external operations that fall under our observation, while it is probably also itself affected by the same laws which operate in producing the ebb and flow of the sea. The facts which prove the existence of an internal source of heat, altogether apart from that which arises from the influence of the solar rays, are familiar to us all. But its true influence or the degrees of heat which are manifested at any regular depth, or under other defined circumstances, are much more difficult to gauge. "According to tolerably uniform experiments in Artesian wells," our author remarks in his *Cosmos*, "it has been shown that the heat increases on an average about 1° for every 54.5 feet. If this increase can be reduced to arithmetical relations, it will follow, as I have already observed, that a stratum of granite would be in a state of fusion at a depth of nearly twenty-one geographical miles, or between four and five times the elevation of the highest summit of the Himalaya.

Transmission
of heat.

"We must distinguish in our globe three different modes for the transmission of heat. The first is periodic, and affects the temperature of the terrestrial strata according as the heat penetrates from above downwards, or from below upwards, being influenced by the different positions of the sun and the seasons of the year. The second is likewise an effect of the sun, although extremely slow: a portion of the heat that has penetrated into the equatorial regions moves in the interior of the globe towards the poles, where it escapes into the atmosphere and the remoter regions of space. The third mode of transmission is the slowest of all, and is derived from the secular cooling of the globe, and from the small portion of the primitive heat which is still being disengaged from the surface. This loss experienced by the central heat must have been very considerable in the earliest epochs of the earth's revolutions, but within historical periods it has hardly been appreciable by our instruments. The surface of the earth is therefore situated between the

Cooling of
the globe.

glowing heat of the inferior strata and the universal regions of space, whose temperature is probably below the freezing point of mercury.

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“ The periodic changes of temperature which have been occasioned on the earth’s surface by the sun’s position and by meteorological processes, are continued in its interior, although to a very inconsiderable depth. The slow conducting power of the ground diminishes this loss of heat in the winter, and is very favourable to deep-rooted trees. Points that lie at very different depths on the same vertical line attain the maximum and minimum of the imparted temperature at very different periods of time. The further they are removed from the surface the smaller is this difference between the extremes. . In the latitudes of our temperate zone (between 48° and 52°) the stratum of invariable temperature is at a depth of from 59 to 64 feet, and at half that depth the oscillations of the thermometer, from the influence of the seasons, scarcely amount to half a degree. In tropical climates this invariable stratum is only one foot below the surface, and this fact has been ingeniously made use of by Bousingault to obtain a convenient, and, as he believes, certain determination of the mean temperature of the air of different places. This mean temperature of the air at a fixed point, or at a group of contiguous points on the surface, is to a certain degree the fundamental element of the climate and agricultural relations of a district; but the mean temperature of the whole surface is very different from that of the globe itself. The questions so often agitated, whether the mean temperature has experienced any considerable differences in the course of centuries, whether the climate of a country has deteriorated, and whether the winters have not become milder and the summers cooler—can only be answered by means of the thermometer; this instrument has, however, scarcely been invented more than two centuries and a half, and its scientific application hardly dates back 120 years. The nature and no-

Penetration
of changes
temperature

Stratum of
invariable
temperature

Changes of
temperature

CHAPTER
XXVIIIInternal heat
of the earth.

velty of the means interpose, therefore, very narrow limits to our investigation regarding the temperature of the air. It is quite otherwise, however, with the solution of the great problem of the internal heat of the whole earth. As we may judge of uniformity of temperature from the unaltered time of vibration of a pendulum, so we may also learn from the unaltered rotatory velocity of the earth the amount of stability in the mean temperature of our globe. This insight into the relations between the *length of the day and the heat of the earth* is the result of one of the most brilliant applications of the knowledge we had long possessed of the movement of the heavens to the thermic condition of our planet. The rotatory velocity of the earth depends on its volume ; and, since by the gradual cooling of the mass by radiation, the axis of rotation would become shorter, the rotatory velocity would necessarily increase, and the length of the day diminish, with a decrease of the temperature. From the comparison of the secular inequalities in the motions of the moon with the eclipses observed in ancient times, it follows that since the time of Hipparchus, that is, for full 2000 years, the length of the day has certainly not diminished by the hundredth part of a second. The decrease of the mean heat of the globe during a period of 2000 years has not, therefore, taking the extremest limits, diminished as much as 1-306th of a degree of Fahrenheit.

Relations of
motion and
heat.Invariability
of form.

“ This invariability of form presupposes also a great invariability in the distribution of relations of density in the interior of the globe. The translatory movements, which occasion the eruptions of our present volcanoes, and of ferruginous lava, and the filling up of previously empty fissures and cavities with dense masses of stone, are consequently only to be regarded as slight superficial phenomena affecting merely one portion of the earth's crust, which, from their smallness when compared to the earth's radius, become wholly insignificant.”

Such are some of the remarkable *readings of nature*,

as we may term them, which the venerable philosopher has achieved by the careful study of the phenomena presented to his observation. The interpretation is not indeed to be accepted entirely as an established law. Various opinions have been advanced to account for the internal heat of the planet, and its increasing temperature at various depths below the surface. Not the least important or curious of these relate to the mysterious principle of magnetism. Changes of temperature, it is now well ascertained, do call forth magnetic and electric currents; but the phenomena exhibited by terrestrial magnetism are still only very partially understood, and these, as well as many other great natural laws, must await the labours of others for their complete elucidation. They bear, however, to an extent of which we are yet only very imperfectly aware, on the important subject elucidated by our author in his "Researches on the Causes of the Inflexion of the Isothermal Lines;" and which he has extended as an addition to a previous valuable "Memoir" on the same subject. Some of the important views indicated in these Researches have been traced on a previous page. But the entire treatise is of the utmost value to the natural philosopher, as well as of direct practical worth in relation to many departments of our modern political economy. It contains the most important exposition of philosophic views on climate and the distribution of temperature which have ever been set forth by any single individual. The full value of these researches are still very partially appreciated, and they have yet almost wholly to be turned to their full practical account in relation to navigation, agriculture, colonization, and the various economic forms to which the researches of the profound observer are reducible for the amelioration and progress of his race.

Such is a slight sketch of Baron Humboldt's Researches in Central Asia, and of some of the valuable facts and important deductions which have already resulted from his labours. Many of his speculations are too profound,

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currents.

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and of too abstract a character, to be readily reducible a popular form. They are, moreover, advanced, in 1 most extensive works, in a form which adds considerably to the difficulty of the ordinary student in attempting to master them. A want of method has, indeed, been complained of in all his works, pertaining not to the accuracy of his scientific observations, but to the absence of any well defined system in their arrangement. Other difficulties occur to the student who seeks to master his discoveries in the form in which they were originally presented. One of the most practical of these is thus referred to by Dr. Alison: "Akin to this is another fault of a more irremediable kind, as it originates in the varied excellences of the author, and the vast store of information on many different subjects which he brings to bear on the subject of his travels. He has so many topics of which he is master himself, that he forgets with how few, comparatively, his readers are familiar; he sees so many objects of inquiry—physical, moral, and political—in the countries which he visits, that he becomes insensible to the fact that, though each probably possesses a certain degree of interest to each reader, yet it is scarcely possible to find one to whom, as to himself, they are *all alike* the object of eager solicitude and anxious investigation. Hence, notwithstanding his attempt to detach his Personal Narrative from the learned works which contain the result of his scientific researches, he has by no means succeeded in effecting their separation. The ordinary reader, who has been fascinated by his glowing description of tropical scenery or his graphic picture of savage manners, is, a few pages on, chilled by disquisitions on the height of the barometer, the disc of the sun, or the electricity of the atmosphere; while the scientific student, who turns to his works for information on his favourite objects of study, deems them strangely interspersed with rhapsodies on glowing sunsets, silent forests, and sounding cataracts. It is scarcely possible to find a reader to

whom all these objects are equally interesting ; and therefore it is scarcely to be expected that his travels, unrivalled as their genius and learning are, will ever be the object of general popularity."

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The fault, it will be seen, is one fully as much of the reader as the author. Nevertheless it is such as will ever in some respects preclude the great mass of readers from studying the discoveries and researches of this distinguished scientific traveller directly from his own works. Like our own Newton, his vast contributions to science may be compared to a treasure of gold, the value of which cannot be augmented, but it may be reduced into a more convenient form of currency. Such is the process which is being applied to the profound researches of Alexander Von Humbolt, and already we see his works assuming a popular form, and circulating throughout the various countries of Europe, disseminating knowledge and instigating to further investigation.

Discursive
treatment of
subject.

Any formal eulogy on the great and illustrious author of these Researches would be entirely out of place here. It has been his fortune to experience what few profound scientific discoverers have done. Surviving to the extreme verge of the usual lot of human life, he has enjoyed in the calm serenity of an honoured old age the full appreciation of the labours of a life-time, and has been able to accomplish much, though he has not completed all the gigantic projects of his vast ideal. He thus introduces the comprehensive work, which he has offered as a "Sketch of a Physical Description of the Universe," in the preface which he addresses to his own fellow countrymen :—"In the late evening of an active life I offer to the German public a work, whose undefined image has floated before my mind for almost half a century. I have frequently looked upon its completion as impracticable, but as often as I have been disposed to relinquish the undertaking, I have again—although perhaps imprudently—resumed the task. This work I now present

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thor.

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description
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to my contemporaries, with a diffidence inspired by a just mistrust of my own powers, whilst I would willingly forget that writings long expected are usually received with less indulgence.

Scientific
occupations

— Although the outward relations of life, and an irresistible impulse towards knowledge of various kinds, have led me to occupy myself for many years—and apparently exclusively—with separate branches of science, as, for instance, with descriptive botany, geognosy, chemistry, astronomical determinations of position, and terrestrial magnetism, in order that I might the better prepare myself for the extensive travels in which I was desirous of engaging, the actual object of my studies has nevertheless been of a higher character. The principal impulse

Objects
aimed at.

by which I was directed, was the earnest endeavour to comprehend the phenomena of physical objects in their general connection, and to represent nature as one great whole, moved and animated by internal forces. My intercourse with highly-gifted men early led me to discover that, without an earnest striving to attain to a knowledge of special branches of study, all attempts to give a grand and general view of the universe would be nothing more than a vain illusion. These special departments in the great domain of natural science are, moreover, capable of being reciprocally fructified by means of the appropriate forces by which they are endowed. Descriptive botany, no longer confined to the narrow circle of the determination of genera and species, leads the observer who traverses distant lands and lofty mountains to the study of the geographical distribution of plants over the earth's surface, according to distance from the equator and vertical elevation above the sea. It is further necessary to investigate the laws which regulate the differences of temperature and climate, and the meteorological processes of the atmosphere, before we can hope to explain the involved causes of vegetable distribution; and it is thus that the observer who earnestly pursues the path of knowledge is led from one class of phenomena to another,

Descriptive
botany.

by means of the mutual dependence and connection existing between them.

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“I have enjoyed an advantage which few scientific travellers have shared to an equal extent, namely, that of having seen not only littoral districts, such as are alone visited by the majority of those who take part in voyages of circumnavigation, but also those portions of the interior of two vast continents which present most striking contrasts, manifested in the Alpine tropical landscapes of South America, and the dreary wastes of the steppes in Northern Asia. Travels, undertaken in districts such as these, could not fail to encourage the natural tendency of my mind towards a generalization of views, and to encourage me to attempt, in a special work, to treat of the knowledge which we at present possess, regarding the sidereal and terrestrial phenomena of the Cosmos in their empirical relations. The hitherto undefined idea of a physical geography has thus, by an extended and perhaps too boldly imagined plan, been comprehended, under the idea of a physical description of the universe, embracing all created things in the regions of space and in the earth.

Advantages
as a tra-
veller.

Encourage-
ments to
generaliza-
tion.

“The very abundance of the materials which are presented to the mind for arrangement and definition, necessarily impart no inconsiderable difficulties in the choice of the form under which such a work must be presented, if it would aspire to the honour of being regarded as a literary composition. Descriptions of nature ought not to be deficient in a tone of life-like truthfulness, whilst the mere enumeration of a series of general results is productive of a no less wearying impression than the elaborate accumulation of the individual data of observation. I scarcely venture to hope that I have succeeded in satisfying these various requirements of composition, or that I have myself avoided the shoals and breakers which I have known how to indicate to others. My faint hope of success rests upon the special indulgence which the German public have bestowed upon

Abundant
materials.

Difficulties
in their
application.







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